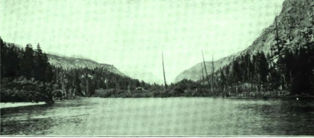


FIG. 7. VIEW UPSTREAM FROM SANDSPIT AT HEAD OF KERN LAKE; SHOWS SLACK WATER IN RIVER.

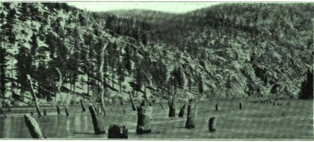
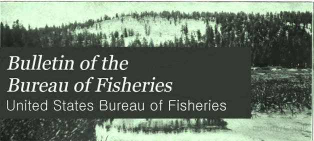


FIG. 8. KERN LAKE FROM NEAR ITS HEAD; SHOWS STUMPS OF SUBMERGED TREES.



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VOL. XXV

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THE GOLDEN TROUT OF THE SOUTHERN HIGH SIERRAS

By BARTON WARREN EVERMANN

Assistant in Charge of Division of Scientific Inquiry, Bureau of Fisheries

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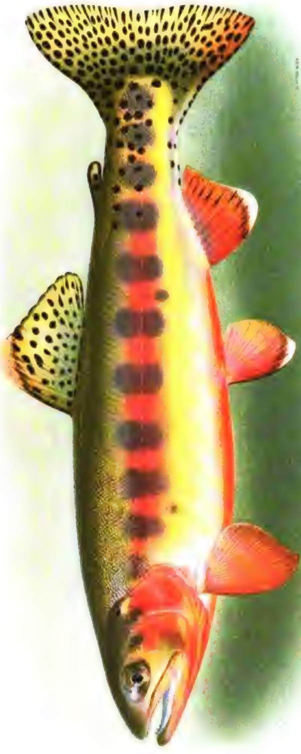

GOLDEN TROUT OF VOLCANO CREEK, SALMO ROOSEVELTI EVERMANN
(DRAWN FROM LIFE BY CHARLES B. HUDSON FROM THE
TYPE, A SPECIMEN 11½ INCHES LONG.)

THE GOLDEN TROUT OF THE SOUTHERN HIGH SIERRAS.

By BARTON WARREN EVERMANN,
Assistant in Charge of Division of Scientific Inquiry, Bureau of Fisheries.

In 1893 Dr. David Starr Jordan described from the southern High Sierras a species of golden trout which he named *Salmo mykiss aqua-bonita*. The description was based on three specimens received by him from Mr. W. H. Shockley, of San Francisco, to whom they had been sent by Mr. George T. Mills, fish commissioner of Nevada. At the time the description was written it was supposed that the specimens came from Volcano (then called Whitney) Creek, but it was subsequently learned that they really came from Cottonwood Creek, into which it was said the species had been transplanted from Volcano Creek. In 1893 Dr. Charles H. Gilbert visited the upper Kern River region and secured color notes on examples of golden trout which he caught in Volcano Creek, and upon others which he obtained from the South Fork of the Kern.

Although it was apparent from the original description and Dr. Gilbert's notes that the trout described by Dr. Jordan was a fish of unusual beauty, and that the species found in Volcano Creek was even more beautiful, little was added to our knowledge of the trout of the Kern River region until recently. From time to time reports had come to the Bureau of Fisheries regarding the beauty, gameness, and delicious flavor of the golden trout of Volcano Creek, and then the fear began to be expressed that, owing to its extremely restricted habitat and the ease with which it may be captured, the species was in danger of extermination.

Stewart Edward White visited the region in 1903 and, impressed with the ease with which the extinction of the species could be compassed, called the attention of the President to the matter and the President in turn brought it to the attention of Hon. George M. Bowers, Commissioner of Fisheries. Complying with the request of the President, the Commissioner ordered an investigation to be made for the purpose of determining (a) the natural geographic distribution of this trout, (b) its abundance, (c) its habits as to food and spawning time and its qualities as a food and game fish, (d) into what waters, if any, it has been transplanted, (e) into what other streams it may be introduced, (f) whether its artificial propagation can be undertaken by the Bureau, and, finally, (g) what measures or regulations, if any, are necessary for the adequate protection of the species. An investigating party, under the writer's direction,[a] outfitted at Redstone Park, Tulare County, Cal., with saddle horses, pack animals, and camping equipment, and on July 13, 1904, started for Volcano Creek.

---

[a] The other members of the party were Prof. Oliver P. Jenkins and Prof. Rufus L. Green, of Stanford University; Prof. Chancey Juday, of the University of Colorado; Mr. Charles B. Hudson, of Detroit, Mich., artist of the expedition, and necessary assistants, packers, and cook.

STREAMS AND LAKES EXAMINED.

That portion of the southern High Sierras drained by the Kings, Kaweah, and Kern and, on its eastern slope, by numerous small streams tributary to Owens Lake, is marvelously rich in mountain streams and small mountain lakes. Practically all of them are naturally well suited to trout. The waters are usually clear and cold and free from injurious contamination. The supply of fish food is ample; entomostraca and other small crustaceans, as well as aquatic insects and insect larvæ, abound. Yet many of these lakes as well as many of the streams in their upper courses are entirely without fish of any kind. All the larger streams were originally well supplied with trout and, in their lower warmer portions, with suckers and minnows, and these fishes, especially the trout, naturally pushed their way up the main streams and also into the tributaries until they came to waterfalls which proved impassable barriers. Many of these streams have such barriers somewhere in their course.

In nature, fishes are found only in those streams and lakes which they have been able to reach from some other stream or lake. Usually the invasion of any stream is from below; and falls that fishes can not surmount prove a final obstruction; no fish will be found in that stream or any of its connecting waters above that point. Occasionally by eating back into the watershed one stream may steal a portion of the headwaters of another on the other side of the divide, and fishes sometimes enter a water course in that way. This, however, happens but rarely. In the region under consideration the streams are typical mountain streams, all more or less turbulent, containing many rapids, cascades, and waterfalls, and with long, relatively quiet reaches where the waters flow through mountain meadows. The larger streams flow through deep canyons, often with sheer walls several hundred feet high, extending back from the top of which is the relatively level high plateau, traversed by many smaller streams. Many, perhaps most, of these tributary streams leave the plateau in a series of cascades and falls, the latter sometimes many feet in a sheer drop, and all picturesque and beautiful. These falls, in nearly all the streams tributary to Kern River above the mouth of the Little Kern and in those in the upper courses of the Kaweahs and Kings, have proved impassable barriers, and the streams above the falls are wholly without trout or any other fish. Some of these barren waters, however, have been stocked by private individuals, fish and game clubs, or by the state and federal governments.

KAWEAH RIVER.

Kings, Kaweah, and Kern are the three great rivers of the southern High Sierras, which together constitute the headwaters of the San Joaquin. The Kings and the Kern have their principal headwaters among the high mountains north of Mount Whitney, Kings flowing westward and the Kern almost directly south. In the right angle between these two rivers and approximately bisecting it is the Kaweah, flowing southwest. All of these rivers finally reach that great area of low tule land in the upper (southern) end of the San Joaquin Valley, of which Tulare Lake is the center. As a result of various agencies, chief of which are the extensive irrigation operations now carried on in this portion of the San Joaquin Valley, only a relatively small proportion of the water which these rivers bring down from the mountains ever reaches

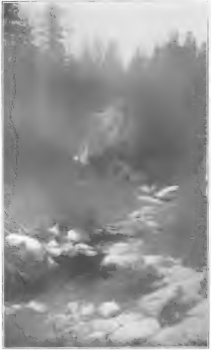

FIG. 1. MARBLE FORK OF KAWEAH RIVER, LOOKING DOWNSTREAM FROM BRIDGE ON ROAD TO THE GIANT FOREST.

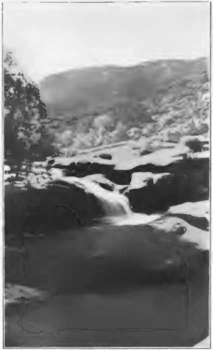

FIG. 2. SOUTH FORK OF KAWEAH RIVER, NEAR ALLES' RANCH.

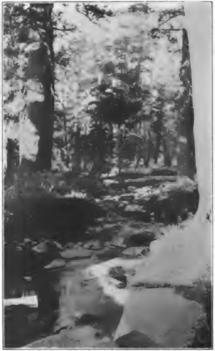

FIG. 3. SOUTH FORK OF KAWEAH RIVER, NEAR HEAD, AT SOUTH FORK MEADOWS. THE TYPE SPECIMEN OF SALMO WHITEI WAS CAUGHT IN THIS POOL.

Tulare Lake or the tule land about it, and most of the latter is now under cultivation and the lake has practically disappeared.

Middle Fork of Kaweah River.—The Middle Fork of Kaweah River was examined at various places from the mouth of the South Fork to a point above the power house, some 10 miles up the stream. In this portion of its course the Middle Fork is a large, swiftly flowing stream, with an occasional deep, quiet pool, but ordinarily with a strong current and a depth of 3 to 10 feet or more. The bed rock is of granite, which in many places is bare. Many large boulders also occur in the stream. There are some rapids and an occasional small fall, at the foot of which are deep pools in which trout delight to loiter. The water is clear, pure, and fairly cold, the maximum temperature in July being about 65° Fahrenheit. Trout were formerly not uncommon in this river, even down to Threerivers and below, but now they are rarely seen below the mouth of the East Fork. The Marble Fork of the Kaweah joins the Middle Fork just south of the Giant Forest. It was examined in the vicinity of the crossing of the road west of the forest, where it is a fine mountain stream well suited to trout. (Pl. II, fig. 1.)

North Fork of Kaweah River.—The North Fork was examined from Broder and Hopping's place at Redstone Park to its mouth, a distance of about 2 miles. This stream is similar to the Middle Fork in every respect except that it is much smaller. In the North Fork trout are not now found lower down than within 10 miles of the mouth.

East Fork of Kaweah River.—The East Fork heads at Farewell Gap and joins the Middle Fork about 4 miles above Threerivers. This stream was inspected at various places between its source and its mouth. It is, in most places, bold and turbulent, with granite bed and many cascades and considerable falls.

South Fork of Kaweah River.—The South Fork was examined at various places between its source and mouth, particularly in that portion 3 to 4 miles above its mouth, also at Alles's ranch, Sand Meadow, and above the last-named place. The South Fork, in its lower course, resembles the North Fork. It is, perhaps, somewhat more turbulent and the water rather colder. At and above Alles's ranch it is a very rough stream averaging 6 feet wide and 1 foot deep, flowing with many falls, cascades, and rapids over a smooth-worn granite bed. (Pl. II, fig. 2.) The temperature of the water at Alles's ranch at 5 p. m. (July 13) was 70.5° Fahrenheit, and at 5.45 a. m. (July 14), 62.25°. Five or 6 miles above this point it was 62.5° at 11 a. m. and at noon at Redwood cabin it was 63°. At Camp No. 2,[a] about 2 miles below Sand Meadow or 7 miles above Ladybug, the South Fork is a mere creek about 10 feet wide, 1 foot in average depth, and with a slow current. The bed is of clean sand and gravel. The water is clear and cool, the temperature varying from 50.25° at 6 a. m. July 15 (when the air was 31.5°) to 60.5° at 7 p. m. The banks are lined with patches of small willows.

The third camp was made in South Fork Meadows, southeast of Sand Meadow and about 7 miles from Camp No. 2. The South Fork at this place is a very small stream, 2 to 10 feet wide and a few inches deep, flowing usually with a slow current (about 393 gallons per minute) over a bottom of coarse white sand, with here and there deeper pools, and at other places considerable riffles over boulders of various sizes. (Pl. II, fig. 3.) Usually below each riffle is a pool from a few inches to 2 feet deep, in which the trout are generally found. In the meadow the overhanging grassy banks afford hiding places for the trout. There are small willows along the banks in some places. There are really 3 streams in this region, viz, the one just described, which flows approximately north; another flowing westward from Cabin Meadow and joining the first at our camp, and a third which heads near Wet Meadow and flows westward, joining the main stream just above Sand Meadow. These streams are only 3 or 4 miles long and are much alike. The temperature of the water in the stream at Camp No. 3 varied from 44° at 7.30 a. m. to 58° at 3.45 p. m.

---

[a] The route followed in these investigations, with the camps indicated by numbers, is shown on the accompanying map (p. 52.)

Fishes are not abundant in the South Fork of the Kaweah. In the lower 3 or 4 miles of the river the western sucker (*Catostomus occidentalis*), the chub (*Ptychocheilus oregonensis*), and the "lake fish" (*Mylopharodon conocephalus*) occur, though only in limited numbers. *Rutilus symmetricus* also occurs, in some abundance. About 3 miles above the mouth trout are found. They appeared to be fairly numerous, but are usually small.

According to Mr. John Broder, of Redstone Park, the present trout in the different forks of the Kaweah are descended from trout artificially introduced, the fish having been planted near the mouths of the respective forks. Prior to 1867–68 a few trout were found in these streams, but they were probably all killed by the great flood of that year. Mr. Ira Blossom, who was recently interviewed by Mr. Broder, and who settled on the South Fork in 1866, says there were speckled trout in that stream then. After the flood of 1867–68 no trout were seen until after the streams had been restocked. About 1884 Mr. J. W. Pogue had a few trout placed in the Main Fork of the Kaweah, and in 1893 the Visalia Sportsman's Club secured a consignment of trout from the state hatchery and planted them in the various branches of the Kaweah. It is said that the stock consisted of rainbow trout and eastern brook trout, that the rainbow thrived, but that the latter did not do well. Mr. Broder says, however, that he has heard of an occasional one being caught. The headwaters of the South Fork of the Kaweah were stocked with trout from Soda Creek at Quinn's Horse Camp.

TULE RIVER.

Middle Fork of Tule River.—The various headwaters of the Tule River originate about the south edge of the Sequoia National Park, between those of the South Fork of the Kaweah on the north and western affluents of the Little Kern on the east. There are several forks, all coming together after getting out of the foothills, only to lose themselves again in the intricate delta of tule land east of Lake Tulare. The Middle Fork was the only stream of this system that we examined. While camped at South Fork Meadows (July 15–17) two members of our party made a side trip to this stream, crossing over the divide south of South Fork Meadows. On the summit was found a small lake, apparently containing no fish, about 250 yards by 150 yards, draining into the Middle Tule. The latter at the place visited is a small stream resembling the headwaters of Soda Creek. (Pl. III, fig. 4.)

The various branches of the Tule River are said to have been originally without trout, but were stocked several years ago by the state fish commission. Trout were found to be abundant in the Middle Tule. The specimens preserved closely resemble the McCloud River trout, and it is probable that the stock came from that stream.

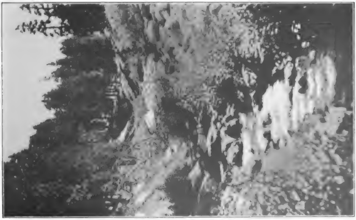

FIG. 4. MIDDLE TULE RIVER AT HEADWATERS.

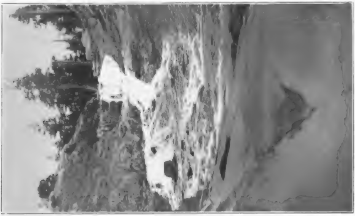

FIG. 5. FIRST SERIES OF FALLS IN LITTLE KERN RIVER, ABOUT 1 MILE ABOVE HOCKETT TRAIL CROSSING.

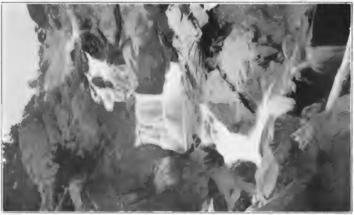

FIG. 6. UPPER PART OF FIRST SERIES OF FALLS IN LITTLE KERN RIVER, ABOVE HOCKETT TRAIL CROSSING.

KERN RIVER.

Kern River is in some respects one of the most interesting streams in the Sierras. Its headwaters are among that group of stupendous mountain peaks from Table Mountain (14,000 feet) in the Great Western Divide eastward through Mount Geneva, Crag Ericsson, Leland Stanford University Peak (14,103 feet), Junction Peak (14,000 feet), Mount Tyndall (14,101 feet), Mount Williamson (14,448 feet), Mounts Barnard, Tunnabora, and Wokorope to Mount Whitney (14,522 feet), the highest and greatest of them all. (Pl. VI, figs. 14 and 15.)

The course of the Kern is remarkable in that it is rectilinear and meridional, it being almost exactly due south for a distance of more than 28 miles, without windings or curves of importance through the great Kern River Canyon, which for sublimity, as well as beauty of scenery, rivals the Yosemite. The direction of the canyon was, according to Professor Lawson, determined originally by a straight rift which has controlled subsequent erosion, and the canyon is therefore both a rift valley and an erosional trough. The Kern River is a considerable stream, carrying a large amount of water. At the ford just above Soda Spring the stream was on July 22 about 40 feet wide, with an average depth of 18 inches and a strong current. The water was clear and cold. The total length of this river is probably 120 to 150 miles, and the entire portion lying above the foothills of the Sierras is good trout water.

The tributary streams are many. Those of importance on the west, beginning at the north, are Milestone Creek, Kern-Kaweah River, Chagoopa Creek, Funston Creek, The Big Arroyo, Rattlesnake Creek, Laurel Creek, Coyote Creek, and Little Kern River; those on the east, from north to south, are Tyndall Creek, East Fork of Kern River, Whitney Creek, Rock Creek, Volcano Creek, Nine Mile Creek, Monache Creek, and South Fork of Kern River. The only ones of these examined during the present investigations were Little Kern River (and certain of its tributaries), Coyote Creek, Whitney Creek, Rock Creek (and Guyot and Siberian Outpost creeks, two of its tributaries), Volcano Creek, and South Fork of Kern River.

Kern Lake.—Just below Soda Spring and the mouth of Volcano Creek is an enlargement or widening in Kern River known as Kern Lake. This lake was formed in the spring of 1868 by a landslide or, more properly, by the washing of a large amount of débris from a small canyon on the east side and depositing it in the canyon of the Kern across the stream and completely damming it. The dam is now triangular in shape and extends out from the east wall of the canyon. It is about an acre in extent, and most of it was not more than 4 or 5 feet above the surface of the lake at the time of our visit. The dam appears to have raised the water at least 10 feet, as shown by stumps of trees standing in water 10 feet deep. Most of these trees have been broken off at the water level, but several still project 1 to 10 or 15 feet above it. The lake is about a mile long and half a mile wide. The deepest water is at the lower or south end on the east side, where it reaches a maximum of 13 feet. Three soundings taken near the lower end gave 8, 8.5, and 10 feet; a series of six at the lower end of the lake just west of the outlet gave 10.5, 10.5, 10.5, 10.5, 10.5, 11, and 11.5 feet; and another series just east of the outlet gave 11, and 12 feet.

The stream has cut its way through the west end of the dam. The upper end of the lake is silting up rapidly, and it is a matter of but a few years until the lake as such will have entirely disappeared. The sand delta is now extending out into the lake in a series of fingers, with intervening channels, and the basin is already about halfway silted up. Upon this delta at the upper end is a thick growth of young cottonwoods and willows. The greater part of this silted-up area is only a few inches above the surface of the water, and the water in the channels through it is only 18 inches or less in depth. The depth over a greater part of the lake is 6 to 10 feet, and there is a dense growth of aquatic vegetation covering nearly all the lake from the sand bars to the dam. This consists mostly of a species of *Potamogeton*, a *Batrachium*, and various filamentous algæ. The white water crowfoot (*B. trichophyllum*) is the most abundant species and covers the surface where the water is not over 5 or 6 feet deep. In the lower end of the lake on the west side a large number of logs have accumulated in sluggish water, forming a considerable jam, as well as a favorite resort for the numerous suckers that inhabit the lake. The river for about three-fourths of a mile below the lake is deep and sluggish, the depth being perhaps 6 to 10 feet. (Pl. IV, figs. 7 and 8, pl. V, figs. 10 and 11.)

About half a mile below Kern Lake is a smaller similar lake, known as "Little Lake" or "Lower Kern Lake," which is said to have had a similar but earlier origin. (Pl. XIII, fig. 36.) It is about half a mile in diameter and is separated from the river by a levee of sand and silt on its east side, the river flowing a straight course at the base of the east wall of the canyon. The outlet of the lake is a small rivulet, which cuts the levee at its southern end.

Little Kern River. This stream has its rise on the east and south slopes of Mount Vandever and Mount Florence at Farewell Gap, flows southeast for about 20 miles, and joins the main Kern River south of Trout Meadow. The greater portion of its course is through a considerable canyon, and the total descent is several thousand feet. The stream was examined by us from its source down to the crossing of the Hockett trail just below the mouth of Wet Meadow Creek. The stream is made up of a succession of falls, cascades, and rapids, with occasional more quiet reaches between. The majority of the falls would not seriously interfere with the free movement of trout, but there are at least two just below the Broder cabin which fish can not now ascend. The stream, however, has trout throughout its entire course and doubtless became stocked before the falls wore down to their present proportions.

Above the crossing of the Hockett trail the Little Kern is a poor trout stream until the falls are reached. The bed is of gravel and the pools are shallow. The falls consist of a series of steep slides and vertical falls, all close together, the total height being about 100 feet. No fall in this portion of the stream is sheer at high water for more than 5 feet. A half mile above these falls are several others which individually are as high as the first falls, but their combined height is less. Above the second falls the pools are larger and deeper and the stream is much better for trout. The fall of this creek is about 400 feet to the mile. At Broder's cabin the volume was about 15,000 gallons per minute. (Pl. III, figs. 5 and 6.)

Wet Meadow Creek is a small western tributary of the Little Kern. It rises just south of Mount Vandever and joins the Little Kern near the crossing of the Hockett trail. It is for most of its length a quiet stream only a few yards or feet

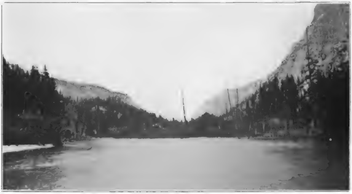

FIG. 7. VIEW UPSTREAM FROM SANDSPIT AT HEAD OF KERN LAKE; SHOWS SLACK WATER IN RIVER.

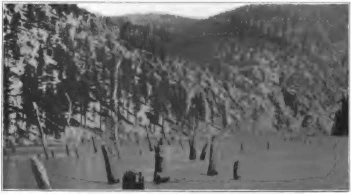

FIG. 8. KERN LAKE FROM NEAR ITS HEAD; SHOWS STUMPS OF SUBMERGED TREES.

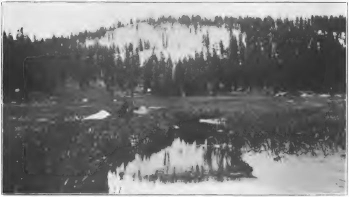

FIG. 9. WET MEADOW CREEK. WHITE'S TROUT IS ABUNDANT IN THIS STREAM.

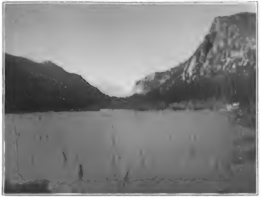

FIG. 10. LOOKING UP KERN LAKE FROM A POINT NEAR OUTLET ON WEST SIDE.

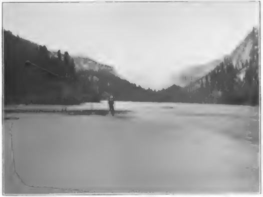

FIG. 11. LOOKING UP KERN RIVER FROM SANDSPIT AT UPPER END OF KERN LAKE.

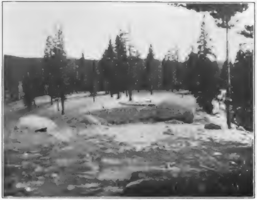

FIG. 12. ALLUVIAL RIDGE SEPARATING VOLCANO CREEK AND SOUTH FORK OF KERN. THE DEPRESSION IN THE CENTER OF PICTURE SHOWS WHERE THE TUNNEL CROSSES.

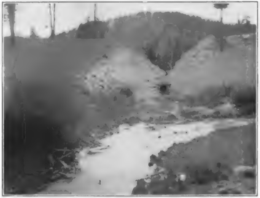

FIG. 13. TUNNEL CONNECTING VOLCANO CREEK AND SOUTH FORK OF KERN, THE LATTER SHOWN IN THE FOREGROUND.

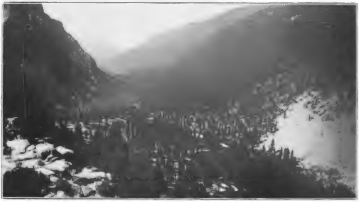

FIG. 14. VIEW OF UPPER KERN RIVER CANYON, LOOKING SOUTH FROM A POINT ON THE EAST WALL ABOVE VOLCANO CREEK. TOWER ROCK IS SEEN ON THE LEFT, THE MAIN TERMINAL MORAINE IN THE MIDDLE-GROUND, AND KERNBUTS LOWER DOWN.

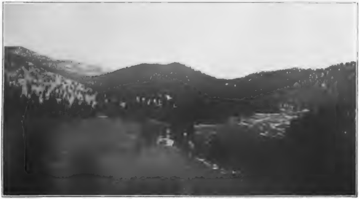

FIG. 15. TOOWA VALLEY, LOOKING EAST FROM SUMMIT OF A VOLCANO 2½ MILES WEST OF THE ONE SHOWN IN THIS VIEW, ILLUSTRATING THE AGGRADED VALLEY BOTTOM AND THE MATURE CHARACTER OF THE SURROUNDING MOUNTAINS.

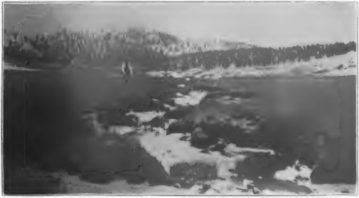

FIG. 16. MEADOW AT SIBERIAN OUTPOST, SHOWING THE SOUTH FORK OF ROCK CREEK, AN IDEAL TROUT STREAM WHICH IS WHOLLY WITHOUT FISH OF ANY KIND.

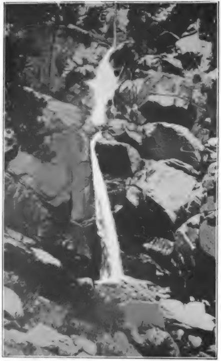

FIG. 17. COYOTE CREEK, SHOWING SECOND AND THIRD (BRODER) FALLS. THESE ARE ABOUT 250 FEET ABOVE THE FIRST FALLS. THE SECOND FALLS IS 50 FEET AND THE THIRD 63 FEET HIGH. THE DISTANCE BETWEEN THEM IS ABOUT 50 FEET.

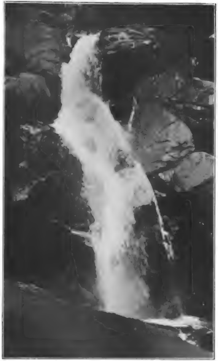

FIG. 18. BRODER FALLS, COYOTE CREEK; HEIGHT, 63 FEET. THIS IS THE THIRD IMPORTANT FALLS, COUNTING FROM THE MOUTH OF THE CREEK.

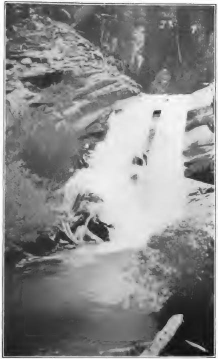

FIG. 19. FOURTH FALLS IN COYOTE CREEK. TROUT ARE FOUND BOTH ABOVE AND BELOW EACH OF THESE FALLS.

wide, meandering through grassy meadows, and with no falls or rapids of any importance. It is well supplied with trout of good size and brilliant coloration. (Pl. IV, fig. 9.)

Soda Creek is a somewhat larger western tributary of the Little Kern. It rises on the divide just west of Quinns Horse Camp, and flows southeast about 6 miles before uniting with the Little Kern. Near its mouth it receives a small tributary from Pecks Canyon. Soda Creek at Quinns Horse Camp is much the same sort of a stream as the South Fork of the Kaweah at South Fork Meadows. It is perhaps a little more turbulent, but has, however, no impassable falls. Trout are abundant. The distance from South Fork Meadows to Quinns Horse Camp is about 5 miles. The elevation of the summit of the pass between the two is 9,680 feet, as given on a United States Geological Survey bench mark.

Coyote Creek.—This is a considerable stream, having its rise on the Western Divide between the main Kern and the Little Kern. Flowing east and southeast a distance of 6 or 8 miles, it enters Kern River just below Soda Spring. Its upper course is through some small meadows, where the stream flows with a gentle current, but the greater portion is through a rugged canyon, in which the descent is very rapid and the stream very turbulent. In drops into Kern Canyon in a series of falls of considerable size and much beauty. The first (lowermost) of these falls is at the edge of Kern Canyon and has a height of 19 feet. The channel of the stream is blocked by a huge boulder, around which the water pours, only a small amount creeping under the boulder. The second and third falls are about 250 feet above the first. The second is about 50 feet high; the third, or Broder Falls[a], 63 feet, and the distance between them about 50 feet. (Pl. VII, figs. 17 and 18.) About one-half mile above the third falls is another, the fourth, which has a vertical descent of about 35 feet. Two hundred feet farther up is a fifth fall, with a drop of about 30 feet. (Pl. VII, fig. 19, and pl. VIII, fig. 20.)

Among these various falls are excellent trout pools, and examples of trout were caught from each of them by some of the members of our party. Above the fifth falls are many others of smaller size, about and among which are numerous deep, relatively quiet pools where trout may be found. As several of these falls now constitute barriers wholly effective in preventing the further ascent of fishes, it is evident that the trout had become distributed the full length of the stream before any of the falls became impassable.

The trout of Coyote Creek show greater variation than is found among those of any other stream in this region. Those taken from below any one of the impassable falls can, as a whole, be distinguished from those above the falls, and it may well be that the effects of isolation are beginning to show on the trout in the different parts of the stream.

Whitney Creek.—This creek has its sources in the snowbanks and tarns on the west and southern slopes of Mount Whitney, whence it flows a trifle south of west to Kern River. The total length is about 8 miles. At Crabtree Meadow a small tributary joins it from the south. Near the head of Whitney Creek are five considerable little lakes or mountain tarns besides a dozen tiny ones. Above Crabtree Meadow the stream is a very rapid one with many boulders, falls, rapids, cascades, and pools. In the meadow it flows with a good strong current. Its width here is about 12 to 15 feet and the depth 10 to 15 inches, with numerous deeper pools. The volume is about 7,320 gallons per minute. The bed of the stream in the meadow is clean white gravel with some black soil and decayed vegetation in the still places. Both above and below the meadow the bed is chiefly granite or granite gravel and boulders. About 1.5 miles below the meadow the stream drops about 200 feet in a close series of falls which fishes can not ascend. There is a beautiful cascade just below the meadow, but it does not form an impassable barrier. From this point the stream descends rapidly in a series of picturesque rapids, cascades, and falls.

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[a] Named for Mr. John Broder, of Redstone Park, Tulare County, Cal., in recognition of the active interest which he has taken in stocking with trout the barren waters of Tulare County.

Whitney Creek is the cleanest, clearest, and coldest of all the creeks we examined, and, although an ideal trout stream, it is entirely without fish of any kind. The lakes at its head (pl. IX, figs. 23, 24, and 25) have an abundance of trout food, consisting chiefly of entomostraca and insect larvæ, and the larger ones should be stocked with trout. The stream also was found to be well supplied with fish food, particularly in Crabtree Meadow and other quiet reaches. (Pl. X, figs. 26 and 27.) Frogs were abundant all along the creek in all suitable places. The temperature of the water at Crabtree Meadow at 6 p. m. July 27 was 56°. Whitney Creek should be stocked with trout from Volcano Creek, and the transplanting could be easily accomplished.

Rock Creek.—This creek has its various headwaters on the western slopes of Mount Le Conte, Old Mount Whitney, and Cirque Peak, and flows west to Kern River, which it enters about 5 or 6 miles south of the mouth of Whitney Creek. From the north it receives a small tributary called Guyot Creek, and from the meadows at Siberian Outpost (pl. VI, fig. 16, and pl. XIV, fig. 38) flows another somewhat larger creek, which joins Rock Creek a mile above the mouth of Guyot Creek. (Pl. XI, fig. 29.) All three of these creeks were examined, and no fish were found in them. They could be easily stocked either from Volcano Creek or the South Fork of the Kern.

Volcano Creek.[a]—On account of the marvelously beautiful trout inhabiting its waters, if for no other reason, Volcano Creek merits a somewhat full description. The course of the stream is peculiar. Its sources are on the slopes of Cirque Peak and among the other cirques of the south end of the High Sierras. A number of small streams come together in and above a series of broad grassy meadows south of Cirque Peak, forming Volcano Creek, which flows slightly west of south a distance of about 8 miles and then turns abruptly westward to pursue a more winding course for about 8 miles farther before joining Kern River opposite Soda Spring.

The sources are at an elevation of 10,000 to 13,000 feet. The upper course is through a succession of small mountain meadows, the larger ones formerly called "Whitney Meadows," but now known as "Volcano Meadows." Except in the more

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[a] This creek on some maps and elsewhere has been called Whitney Creek, a name applied to it when the mountain now called Sheep Mountain, or Old Mount Whitney, was thought to be the real Mount Whitney. When it was found that this stream does not rise near either Mount Whitney or Old Mount Whitney the name Whitney Creek was transferred to the stream described above under that name, and the name "Volcano Creek" was adopted for this stream. In some publications it has been called Golden Trout Creek. The United States Board on Geographic Names has adopted the name Volcano Creek, which therefore becomes the recognized official name.

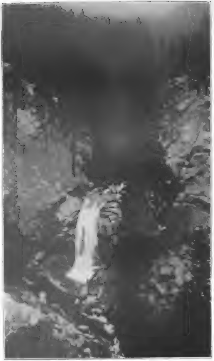

FIG. 20. FIFTH FALLS, COYOTE CREEK, 200 YARDS ABOVE THE FOURTH FALLS; HEIGHT, 30 FEET.

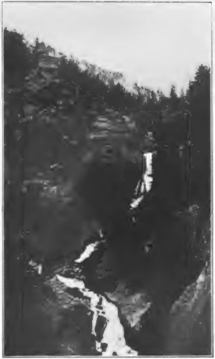

FIG. 21. VOLCANO CREEK, THE HOME OF THE GOLDEN TROUT. THIS SHOWS THE SECOND OR STEWART FALLS AND SECTION OF THE STREAM BELOW.

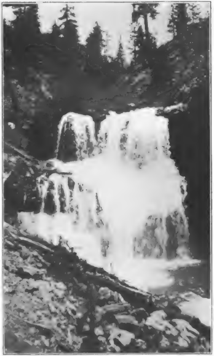

FIG. 22. SHIELDS FALLS, VOLCANO CREEK. THIS IS THE THIRD IMPORTANT FALLS ABOVE THE MOUTH OF THE CREEK. THE TOTAL DESCENT IS ABOUT 50 FEET IN TWO SHEER DROPS OF 25 FEET EACH.

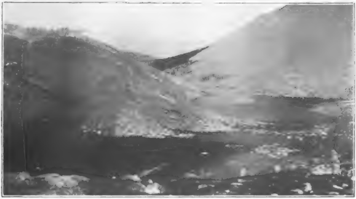

FIG. 23. LANGLEY'S CAMP AND SMALL LAKES AT END OF HORSE TRAIL, BASE OF MOUNT WHITNEY. THE TARNS ARE THE HEADWATERS OF WHITNEY CREEK.

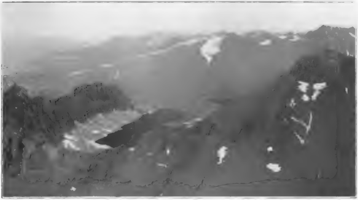

FIG. 24. LOOKING NORTHWEST FROM MOUNT WHITNEY, SHOWING IN THE MIDDLE-GROUND A LARGE CIRQUE WITH TARN.

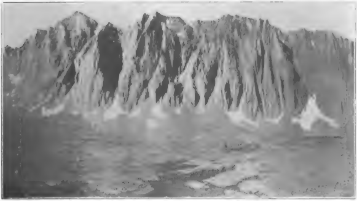

FIG. 25. CLIFFS SOUTH OF LANGLEY'S CAMP, BASE OF MOUNT WHITNEY.

level meadows, where the water flows gently, this portion of the stream is made up of a succession of rapids and small cascades, none, however, constituting a barrier to the ascent of fishes. The total fall from the headwaters to the point where the stream turns west is between 1,600 and 2,000 feet.

The bend to the westward is made just after the stream enters an east-and-west ancient trough or valley which Professor Lawson calls "Toowa Valley," just below the most eastern of the series of small volcanoes or cinder cones which give name to the creek, and at a place known as the "tunnel." The elevation of the creek bed at this point is about 8,600 feet. The floor of Kern Canyon at the mouth of Volcano Creek is 6,300 feet. The drop made by this portion of the creek is therefore about 2,300 feet. (Pl. x, fig. 28).

As already stated, the descent made by the creek above the "tunnel" is without any considerable sheer falls. That portion below the "tunnel" is markedly different. Rapids, cascades, and sheer falls of large proportions and exceeding beauty follow each other in rapid succession, particularly in the last three or four miles. Only in Groundhog Meadow and one or two other small meadows are any quiet reaches found. While there are many rapids and small cascades all along below the tunnel, it is only in the last three or four miles that falls of considerable size are found. A good general view of this portion of the creek is seen in plate VIII, figure 21.

Volcano Creek above the tunnel has a bed of granite sand and gravel with granite boulders of various sizes from small to very large and in great profusion. From the tunnel to the mouth there is not so much granite, but much lava, volcanic tufa, and tufaceous sand.

Though the stream for most of its course is turbulent and wild, there are three meadows of considerable size through which it flows more quietly. Here the banks are of sod or well covered by willows and other shrubs; the bed is of gravel of various sizes, fragments of lava, and finer material from the granite, lava, and soil. Below these meadows is the series of rapids and important falls already mentioned and which are more fully described on page 14.

To understand Volcano Creek it is necessary to consider it in connection with another stream, the South Fork of the Kern. The relations of these two streams are peculiar and unusual. According to Professor Lawson, the South Fork of the Kern has its rise in the Summit Divide, about 3 miles southeast of Cirque Peak, flows southwest about 6 miles, and enters Toowa Valley practically at the same point where Volcano Creek enters it. There it makes an acute bend to the eastward and flows southeasterly through the eastern part of Toowa Valley. (Pl. XI, figs. 30 and 31.) At the point of nearest approach Volcano Creek and South Fork of Kern are separated by a low alluvial ridge not over 75 or 80 yards wide at the level of the beds of the streams. The top of the ridge at the narrowest point is about 50 or 60 feet wide and not to exceed 30 feet above the streams. It is evident that these two streams were at one time tributaries of one stream which, according to Professor Lawson, occupied the Toowa Valley, and the separation of the drainage into two distinct streams, one flowing west and the other east in the same valley, is an interesting problem which has its bearing upon the geomorphy of the region and, as well, upon the origin and relationships of the trout of the two streams.

Volcano Creek originally probably had its outlet to the westward through the same valley in which it now flows. As Kern River cut its canyon deeper and deeper, Volcano Creek did the same, cutting back from Kern Canyon, however, only a mile or two, and doubtless forming considerable falls. During this time it is believed that the portion of South Fork of Kern above the tunnel was a tributary of Volcano Creek. Subsequently the region through which Volcano Creek flows has been materially modified by flows of lava from several volcanoes which appeared on the floor of the valley or near it. Professor Lawson identified six such volcanic cones, at least four of which I was able to locate, one being on the left side of the South Fork just above the tunnel. These small volcanoes sent streams of lava in various directions, particularly down the gorge of Volcano Creek almost to the bottom of Kern Canyon. This lava stream filled the gorge of the lower part of Volcano Creek, which had been cut down nearly to the present Kern level. Above this gorge the stream has been variously obstructed by lava flows, one result of which has been to crowd the stream to the north and northeast sides of the valley. Another and very important result was the damming of the stream and causing the formation of a broad alluvial plain in the vicinity of the craters. Eventually this plain was carried so high as to make the drainage unstable, the stream discharging sometimes by the Volcano Creek Valley, sometimes by the South Fork Valley, and doubtless being sometimes divided between the two. As Volcano Creek partially reopened its ancient channel by eroding the lava, the habit of the upper streams was finally changed, so that, instead of adding to the alluvial deposit, they began to excavate it; and when this change occurred it happened that the main branch of Volcano Creek discharged toward the west, while the eastern branch discharged eastward, constituting the present upper waters of the South Fork. The ridge between the two is merely a remnant of the alluvial deposit and is now only a few yards in width. Its narrowness suggested to certain ranchers living in the valley of the South Fork the possibility of increasing, for irrigation purposes, the flow of water in the South Fork by tunneling the ridge. The level of Volcano Creek is slightly higher than that of the South Fork, and when the ditch or tunnel was made a portion of the water of Volcano Creek flowed into the South Fork. (Pl. v, figs. 12 and 13.) Mr. George W. Stewart, agent of the United States Land Office, Visalia, Cal., has kindly furnished the following information concerning this tunnel:

> From the records of the board of supervisors of Tulare County, Cal., sitting as a board of water commissioners, I find there was presented to the board in 1883 a petition of Patrick Brady and 30 others to be allowed to divert from Whitney [Volcano] Creek at a point near a narrow ridge between Whitney [Volcano] Creek and Ramshaw Creek [South Fork of Kern] 4 miles below Whitney [Volcano] Meadows and 3 miles above Ramshaw Meadows 10,000 miner's inches of water under a 4-inch pressure, the same to be conveyed through a ditch and tunnel, the water to be used for stock, manufacturing, and irrigation, in township 26 south, ranges 33, 34, and 35 east. The said records show that under date of September 13, 1883, it was ordered "That prayer of said petitioners be granted and that they have out of said Whitney [Volcano] Creek, at said point of diversion, sufficient water to fill their ditch—that is, 10,000 inches under 4-inch pressure."
>
> The tunnel was driven through a hill (ridge) composed mainly of disintegrated granite and, I have been informed, soon caved in, and was then transformed into what miners call an "open cut." This also caved in so that it had to be abandoned, and the water was diverted at a higher point on the stream, I believe, about 1½ miles above. I have been told that the amount of water diverted through the tunnel was sufficient to permit the golden trout to escape into Ramshaw Creek. In 1899 when I

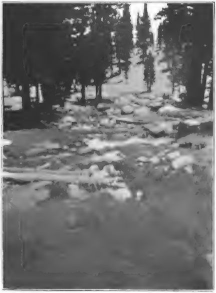

FIG. 26. WHITNEY CREEK AS IT ENTERS CRABTREE MEADOW.

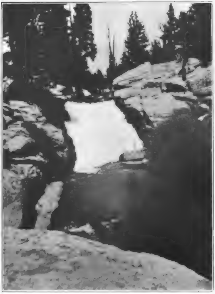

FIG. 27. WHITNEY FALLS IN WHITNEY CREEK JUST BELOW CRABTREE MEADOW.

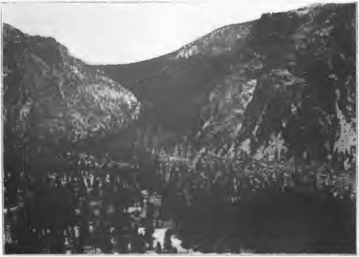

FIG. 28. THE MOUTH OF VOLCANO CREEK CANYON AND THE FLOOR OF THE UPPER KERN CANYON. THE CREEK HAD ONCE CUT DOWN NEARLY TO THE LEVEL OF KERN RIVER, AFTER WHICH IT WAS FILLED WITH LAVA—THE DARK ROCK IN THE MIDDLE OF THE PICTURE. SINCE THEN A NARROW PRECIPITOUS GORGE HAS BEEN CUT, PARTLY IN THE LAVA AND PARTLY BETWEEN IT AND THE GRANITE.

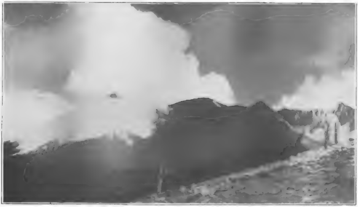

FIG. 29. VIEW NORTH-NORTHWEST FROM SIBERIAN OUTPOST.

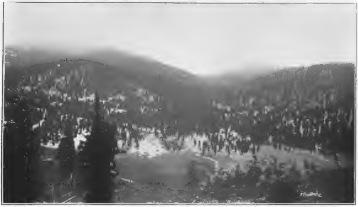

FIG. 30. TOOWA VALLEY, LOOKING EAST FROM SUMMIT OF VOLCANO SHOWN IN PLATE VI, FIGURE 15. THE BROAD, ANCIENT VALLEY FLOOR HAS BEEN DISSECTED AND SINCE AGGRADED TO THE PRESENT MEADOW LEVEL.

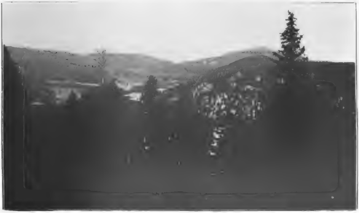

FIG. 31. SOUTH SIDE OF TOOWA VALLEY FROM SAME POINT OF VIEW AS IN FIGURE 30.

> passed the point of diversion mentioned, above the tunnel, about one-half of the volume of the stream was flowing into the ditch over a small dam of brush and rock, and there was nothing to prevent the escape of the fish. The flow of water was abundant for the purpose, and the water in the ditch, as I remember it, was not more than 3 feet below the surface of the water in the creek, and it flowed over a broad dam.
>
> The amount allowed to be diverted [10,000 miner's inches under 4-inch pressure equals 90,000 gallons per minute] was several times the whole volume of water in the creek during the summer months, and at that point I doubt if it exceeded 10,000 inches many days in the year. It is not probable that 10,000 inches was diverted at any time, as it would be possible only during a freshet. Under the order granting the prayer of the petitioners they would have been allowed to divert all the water of Volcano Creek during the period of low water. I have never heard that this was done, and I do not know that it was not done.

At the time of my visit (July 24) the total volume of Volcano Creek at the tunnel was about 4,893 gallons per minute. The tunnel was then entirely closed (as it doubtless has been for many years), only a trifling amount of water seeping through the gravel. The ditch some distance above the tunnel was also closed and no water running in it. Information just received from Mr. Stewart says that no water ran in it in 1905. It is doubtful whether any has run since 1899, and it is hoped that no effort will ever be made again to divert the water of Volcano Creek.

Information given by Mr. John Broder, of Redstone Park, agrees essentially with the above. He states that the tunnel was made about 1883 or 1884, and that it gave trouble by frequently caving in; that it was changed to an "open cut" about 1891, but, continuing to cave in, was soon abandoned. A ditch diverting the water at a point above the tunnel was then dug, about 1892. Mr. Broder says he has seen the water running through the tunnel, the "open cut," and also through the ditch; that there was nothing to prevent the free passage of trout from Volcano Creek, and that fish swimming downstream doubtless found it easier to pass into the ditch or tunnel than to continue down the creek; and Mr. Stewart found this condition existing in 1899. Mr. A. H. Swain, receiver of the United States Land Office at Visalia, was there in 1903 and found no water diverted, the ditch, as well as the tunnel, not being in condition to carry water; and that was the condition at the time of my visit in 1904.

I have heard from various sources that the parties who constructed the tunnel and ditch had been enjoined from diverting the water, but the truth of this statement has not been established. The points of diversion are in Tulare County, and Mr. Stewart informs me that the records of that county do not show that any such injunction was issued.

Professor Lawson further says:

> It is evident that the period of eruption of the volcanoes of the Toowa Valley and the upbuilding of their cones is later than that of the formation of the valley, and that they are features imposed upon, and independent of, the erosional geomorphy of the valley. The valley had evidently attained its present character, as far as erosion is concerned, before the volcanic eruption began, and has been but little modified since eruptive activity ceased, except by aggradation.[a]

The bed of Volcano Creek, however, has undergone considerable modification since the lava flow. This has consisted chiefly in the wearing away of the obstructing lava and in the formation of a number of considerable falls in the last two or three miles of the stream. This portion is very wild (pl. XIV, fig. 39), the total descent in the last 2 miles being about 1,600 feet. Starting at the mouth of the creek, the first fall of importance is found only a short distance back from the river. This is known as Agua-Bonita Falls, and the vertical descent is between 60 and 80 feet. (Pl. XII, fig. 32.) A few rods farther up is a small but very beautiful fall (pl. XIII, fig. 34) with a sheer drop of about 10 feet, which I have named "Surby Falls."[a] About 300 yards above Agua-Bonita Falls is the second, or Stewart Falls[b] (pl. XII, fig. 33), in a series of sheer drops totaling about 70 feet. The next or third important falls (pl. VIII, fig. 22) is several rods farther up stream, and has been named "Shields Falls."[c] It consists of two sheer falls each of about 25 feet. Several rods above these are Twin Falls (pl. XIII, fig. 35), just below the crossing of the trail. These are very beautiful, and have a sheer drop of about 18 feet.

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[a] Lawson, op. cit., p. 321.

These four falls are each and all barriers that fishes can not possibly surmount. Fishes could, of course, go down over them and they doubtless do so, but they do not go out into Kern River. The trout of Volcano Creek are a small, creek-loving species, and evidently avoid the larger stream. The various falls are adequate in keeping Kern River trout from ascending Volcano Creek, and these same falls, together with the size of the stream, are equally adequate in keeping the creek trout from entering Kern River. The trout of Volcano Creek are therefore as completely isolated from those of Kern River as if a land barrier intervened.

That Volcano Creek was originally stocked with trout from Kern River may be accepted without much question. The lava flows already referred to doubtless killed off all the trout of the lower portions of the creek, leaving perhaps only those of the headwaters to reinvade the depleted lower portion after the conditions became suitable. At that time it is probable that the trout of South Fork of Kern (which was presumably also stocked from Kern River) did not materially differ from those of Volcano Creek; but the period that has elapsed since their segregation, due to the formation of the alluvial barrier and the numerous impassable falls, has proved quite sufficient to permit a differentiation which renders them readily distinguishable and, I believe, specifically distinct.

About one-half mile above Twin Falls a small stream from the south enters Volcano Creek. Near its mouth this stream has cut its way through the volcanic tufa and formed a natural bridge (pl. XIV, fig. 37). This bridge is 18 to 20 feet wide, 12 to 15 feet high on the lower side, and 8 to 10 feet high on the upper side.

Masses of this tufa are found in all the more quiet reaches of Volcano Creek from the tunnel down, and in the eddies and deeper pools the bed is largely made up of this material, either as fragments of various sizes or as sand. The color of the tufa is a light lemon-yellow or yellowish white. The tufa seems to dissolve or break down readily in the water, the result being that the water is more or less milky. The similarity in the color of this tufa, and even the general color of the bed of the stream in many places, to certain colors found in the trout forces itself on one's attention.

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[a] Named in memory of Mr. Byrd Surby, of Threerivers, Tulare County, Cal., a member of my party who was killed by lightning on Mount Whitney July 26, 1904.

[b] Named for Mr. George W. Stewart, of Visalia, Tulare County, Cal., president of the Tulare County Fish and Game League and of the Mount Whitney Club, who has done so much toward the stocking of the streams of the southern High Sierras with trout.

[c] In honor of Mr. George O. Shields, who, as editor of Recreation and later of its successor, Shields' Magazine, has done so much for fish and game protection in America.

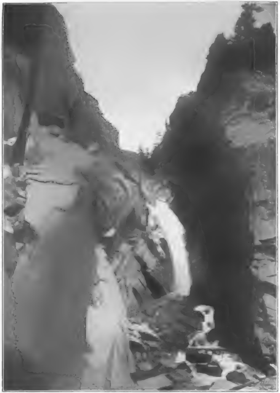


FIG. 32. AGUA-BONITA FALLS. THE FIRST IMPORTANT FALLS IN VOLCANO CREEK ABOVE THE MOUTH. VERTICAL DESCENT BETWEEN 60 AND 80 FEET.

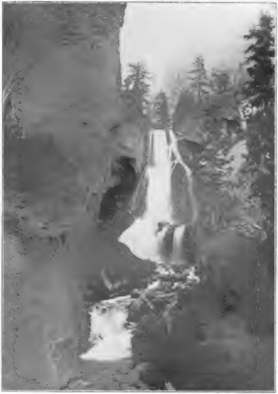


FIG. 33. STEWART FALLS, VOLCANO CREEK. THE SECOND IMPORTANT FALLS ABOVE THE MOUTH OF THE CREEK. TOTAL DESCENT ABOUT 70 FEET.

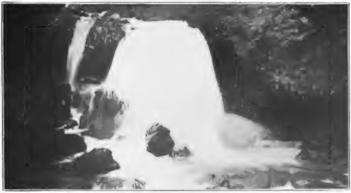


FIG. 34. SURBY FALLS, VOLCANO CREEK, BETWEEN AGUA-BONITA (FIRST) AND STEWART (SECOND) FALLS; HEIGHT ABOUT 10 FEET.

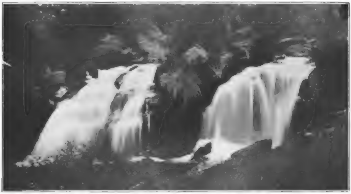


FIG. 35. TWIN FALLS, VOLCANO CREEK, JUST BELOW THE FIRST TRAIL CROSSING; HEIGHT ABOUT 18 FEET.

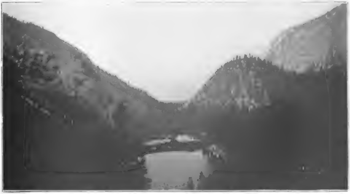


FIG. 36. VIEW DOWN KERN CANYON FROM A KERNBUT BETWEEN UPPER AND LOWER KERN LAKES, SHOWING LOWER KERN LAKE IN FOREGROUND, GREAT ROCK, SLIDE ON LEFT, A TYPICAL KERNBUT ON THE RIGHT, WITH STEEP WALL BEHIND IT, AND THE PROFILE OF THE TROUT MEADOWS DEFILE IN THE DISTANCE.

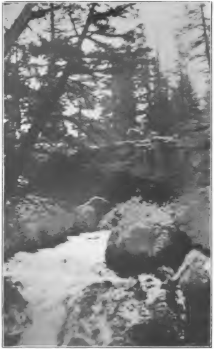


FIG. 37. NATURAL BRIDGE OVER SMALL TRIBUTARY OF VOLCANO CREEK JUST ABOVE FIRST CROSSING OF THE TRAIL. THE CREEK HAS CUT ITS WAY THROUGH AND UNDER A BED OF VOLCANIC TUFA.

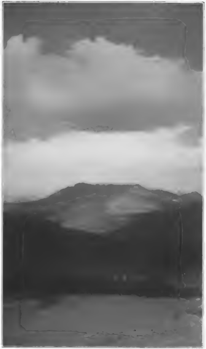


FIG. 38. VIEW FROM SLOPE ABOVE CAMP AT SIBERIAN OUTPOST. MOUNT GUYOT IN CENTER AT RIGHT; REDSPUR OF KAWEAH RANGE IN LEFT CENTER.

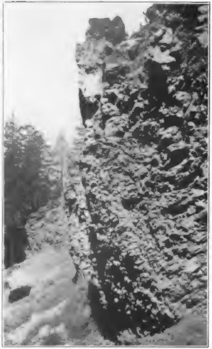


FIG. 39. BASALTIC CLIFF AT FIRST CROSSING OF TRAIL OVER VOLCANO CREEK.

South Fork of Kern River.—This stream has already been mentioned and described in part. It rises southeast of Cirque Peak on the east side of a high mountain ridge separating it from Volcano Creek. For the first six or seven miles its course is west of south until it enters Toowa Valley near the tunnel; there it turns abruptly to the southeast. After flowing through South Fork of Kern Meadows it turns southward, which course it follows for several miles, and then, turning westward, enters the main Kern River a few miles south of Kernville.

The stream was examined by us only in that portion of its course easily reached from the tunnel. At that place it is smaller than Volcano Creek, but below South Fork of Kern Meadows it becomes a considerable stream. At the lower end of these meadows it receives from the north a tributary known as "Mulky Creek," a small stream of special interest because of the fact that the trout with which Cottonwood Creek was originally stocked came from it.

Cottonwood Creek.—A few words should be said of the waters of the east side of the southern High Sierras. Numerous streams of greater or less importance having their headwaters on the eastern slopes of this range flow directly into Owens Lake or into its most important tributary, Owens River. Lone Pine Creek and Turtle Creek have their sources on the east side of Mount Whitney, Mount Le Conte, and Sheep Mountain, opposite Whitney and Rock creeks, and, flowing eastward about 14 miles, enter Owens River at Lone Pine. Cottonwood Creek rises on the eastern slopes of Sheep Mountain and Cirque Peak opposite the headwaters of Rock and Volcano creeks and flows southeast about 15 or 18 miles to Owens Lake. Well toward the head of Cottonwood Creek are said to be some small lakes. All of these streams, so far as known, were originally without trout of any kind. Some of them, however, have been stocked. The circumstances attending the stocking of Cottonwood Creek are explained elsewhere in this report (p. 33).

THE FISHES OF THE KERN RIVER REGION.

There are not many species of fishes in the Kern River region. Two species of suckers, three of minnows (Cyprinidæ), and two of trout seem to be all that have been recorded. But the streams and lakes have not been carefully investigated and it is quite probable other species will be found when more thorough collections are made. Of the two suckers only one was obtained by us. Specimens of the three minnows were secured. As regards the trout, our collections contain more species than have hitherto been recorded from the region, there being at least six represented. They are all save one regarded as belonging to the rainbow trout series and are as follows: (1) the Kern River trout (*Salmo gilberti*), occurring only in Kern River; (2) *Salmo agua-bonita*, native only to the South Fork of the Kern and its tributaries, but introduced from it into Cottonwood Creek; (3) the golden trout of Volcano Creek, which does not occur in any other stream; (4) the Soda Creek trout, found throughout the basin of the Little Kern and in Coyote Creek and introduced from Soda Creek into the headwaters of the South Fork of the Kaweah; (5) the common rainbow trout (*Salmo shasta*), widely introduced by the state fish commission into the waters of the state and found by us in the headwaters of the Middle Tule, the lower course of the South Fork of the Kaweah, the Middle Fork of the

Kaweah, and in Marble Fork; and (6) the common cut-throat (*Salmo clarkii*), introduced into at least some streams of the region and found by us in Marble Fork of the Kaweah.

The Coyote Creek trout are somewhat anomalous in that some of them show considerable red on the throat. It may become necessary to separate these red-throated trout as a distinct species, but for the present the question of their distinctness is held in abeyance.

The following is a systematic list of the fishes thus far known from the Kern River region:

1. **Pantosteus aræopus** (Jordan). *Hard-head Sucker.*

The type specimens of this sucker were collected by Prof. H. W. Henshaw in 1876 in the South Fork of Kern River. They are No. 31228, U. S. National Museum, and are 13 and 9 inches long, respectively. Other young examples were obtained by Mr. Henshaw in Carson River, Nevada. In 1891 Mr. Vernon Bailey collected a specimen in Reese River, Nevada. These are the only specimens that have been recorded. The species was not seen by us.

Catostomus aræopus Jordan, A Synopsis of the Family *Catostomidæ*, in Bull. U. S. Nat. Mus., XII, 173, 1878. Jordan & Henshaw, Report upon the Fishes collected during the years 1875, 1876, and 1877, in California and Nevada, in Annual Report of Chief of Engineers, U. S. Army, for 1878, Appendix N N, p. 1610, pl. III. Gilbert, Rept. on Fishes of the Death Valley Expedition, in North American Fauna, No. 7, p. 229, May 31, 1893.

Pantosteus aræopus, Jordan & Evermann, Fishes North and Middle America, 172, 1896.

2. **Catostomus occidentalis** Ayres. *Sacramento Sucker.*

Common in all the larger streams of the region. Several were seen in the Middle Fork of the Kaweah near Threerivers and in the North Fork at Redstone Park. One of our party caught one with his hands in an irrigating ditch near Redstone Park July 11. Exceedingly abundant in Kern Lake and common in Kern River in all suitable places. At the head of the lake is a good deal of grassy border in water up to 18 inches deep. In this the suckers were common and many were seined. In the lower part of the lake on the west or right side are many logs lying in water 1 to 6 feet deep. Among these logs large suckers were very abundant. When not disturbed they lay quietly in one place or swam slowly about at the surface, nosing around evidently in search of food, sucking off the algæ growing on the logs. Sometimes they might be seen even lying on top of logs that were entirely submerged. As many as twenty or thirty might be seen in one bunch, and there must have been more than a thousand all told among these logs. Some of them were very large, certainly at least 2 feet long. One example, 23 inches long, had the scales 10-70-9; dorsal 12; anal 8; upper lip with 2 rows of papillæ, the lower with 7 or 8.

3. **Mylopharodon conocephalus** (Baird & Girard). *Kaweah Chub; "Lake Fish."*

This fish was found in all the forks of the Kaweah immediately above Threerivers, and doubtless occurs even more abundantly below that place. The largest and most numerous examples were seen in the Middle Fork. It will take almost any kind of lure. Examples were taken with worm, trolling spoon, and artificial fly. It possesses some game qualities, ranking with the Oregon chub in that respect. Both of these species are locally called "lake fish" or "lake trout," evidently from the fact that they were formerly very abundant in Tulare Lake, from which in spring they ascended the streams in great numbers.

4. **Ptychocheilus oregonensis** (Richardson).

Squawfish; Sacramento Pike; "Lake Fish."

This large minnow is abundant in the lower portions of all the forks of the Kaweah. We saw it at all the fords, and specimens were obtained from North Fork at Redstone Park and from Middle and South forks near Threerivers. They were caught with worms, artificial fly, and trolling spoon. Though they would rise to the fly they preferred worms, which they devoured ravenously. One of our party took with the spoon several large examples, one 2 feet long, weighing 6 pounds. Another, taken July 13 by Britten Brothers from the main Kaweah, was 28 inches long and weighed 7.25 pounds. It was a female full of nearly ripe eggs. The larger examples of this species are quite game and make a very good fight.

With the preceding this also is locally called "lake fish" or "lake trout." The people of this region, however, seemed to know very little about these fishes. They consider them bony and rarely eat them.

5. **Rutilus symmetricus** (Baird & Girard).

Head 3.8; depth 4.5; eye 4.3; snout 2.7; scales 12–62–7; D. 9; A. 8; teeth 4–5, hooked and with a narrow grinding surface. Three specimens in the collection from South Fork of the Kaweah above Threerivers July 11, where it was common. They are 4 to 5.5 inches long and are quite dark in color. The two smaller specimens have the tip of the lower jaw hardened into a horny sharp edge. The largest specimen shows only a remnant of this hardened edge.

The species is found chiefly in shallow water. It takes the hook with a vim and will rise to the artificial fly, but prefers worms.

THE TROUT OF THE KERN RIVER REGION.

The native trout of the Kern River region represent at least four well-marked species or subspecies, all belonging apparently to the rainbow-trout series. They are as follows: (1) The Kern River trout (*Salmo gilberti*), occurring only in Kern River and possibly in the lower portions of some of its larger tributaries. The type locality is Kern River at Soda Spring. This is the species from which it is believed all the other native trout of the Kern basin have descended. (2) The Soda Creek trout, native to Soda Creek, Wet Meadow Creek, Little Kern River, Coyote Creek, and possibly other small western tributaries of Kern River, and introduced from Soda Creek into the headwaters of the South Fork of the Kaweah at South Fork Meadows, and elsewhere. (3) The South Fork of Kern golden trout (*Salmo aguabonita*), described originally from Cottonwood Creek, into which it had been introduced, but native only to the South Fork of the Kern and its tributaries. (4) The golden trout of Volcano Creek. This is the real "golden trout" and is native only to the one stream—Volcano Creek.

Comparing the trout from these various streams the following statements appear to be justified:

(1) The Kern River trout is profusely and closely spotted over the entire body, head, and on all the fins, and the belly is not richly colored.

(2) The Soda Creek trout has numerous black spots on head, back, and entire length of side both above and below lateral line, but the pectorals, ventrals, and anal are without spots, and the belly is rich orange in color.

(3) The South Fork of Kern golden trout is sparsely spotted on caudal peduncle, along side only above lateral line, and on top of head. There are no spots below the lateral line. The belly is rich orange.

(4) The golden trout of Volcano Creek is entirely without spots, except on the caudal peduncle and occasionally a few above the lateral line posterior to the dorsal fin. The belly is a very rich cadmium.

The different species may be described in detail as follows:

6. **Salmo gilberti** (Jordan). *Kern River Trout; Gilbert Trout.*

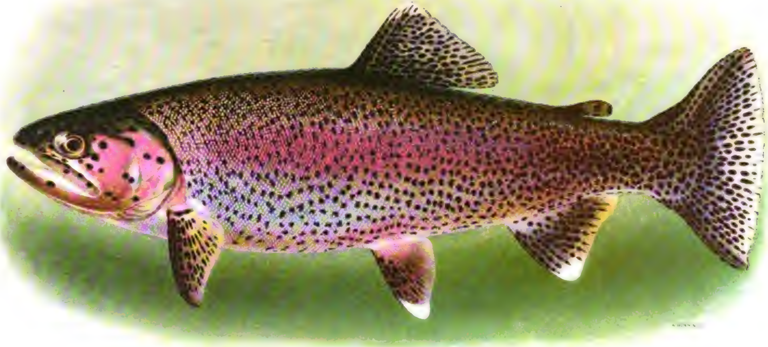
(Plate xv.)

Head 4 in length to base of caudal; depth 3.6; eye 5 in head; snout 4.3; maxillary 1.6; mandible 1.3; preorbital 20; scales small, about 165 in lateral line; dorsal fin with 14 rays; anal 12. Body stout, moderately compressed, deepest slightly in front of dorsal; head long, conic, snout pointed; mouth large, maxillary long and narrow, reaching more than an eye's diameter beyond the eye; mandible slightly curved; teeth on lower jaw rather strong, wide-set, in a single series, those on maxillary strongest; caudal peduncle stout, its least depth equal to snout and eye. Fins all well developed; origin of dorsal midway between tip of snout and base of tail, the longest ray nearly two in head, base of fin slightly greater than height; caudal broad, truncate, the lobes equal, exceeding height of dorsal; base of anal equaling height of fin, also height of dorsal; origin of ventrals somewhat posterior to that of dorsal and much nearer base of caudal than tip of snout, longest ventral ray equal to longest dorsal ray; longest pectoral ray exceeding by one-fourth the height of dorsal.

Color in life, head, body, and fins everywhere profusely and rather uniformly covered with small black spots, those on body stellate, those on fins oblong, those on head roundish and more sparse; inner half of ventral and pectoral less spotted; anterior rays of dorsal scarcely tipped with lighter; anal and ventrals with the anterior rays white at tip; adipose dorsal olivaceous with three or four black spots; side broadly rich rosy red, broadest and brightest near middle, least distinct on caudal peduncle; lower half of side slightly pink and pale bluish; belly with slight irregular wash of old gold on dirty-white ground color; back and upper part of side olivaceous with fine yellow, orange, or lemon specks; cheek and opercles rich rosy; little or no red on throat, no red dash on membrane between rami of lower jaw; few spots on side of head; top of head olive green, well covered with round black spots.

The above description and the accompanying colored plate (pl. xv) from an example (a male) 18.25 inches long and weighing 3.5 pounds caught by me July 19 in Kern River about one-half mile above Kern Lake.

Another example, weighing 2 pounds, taken the same day at the lower end of Kern Lake, was described as follows: Color on back and upper third of side very



KERN RIVER TROUT, SALMO GILBERTI (JORDAN)
(DRAWN FROM LIFE BY CHARLES B. HUDSON FROM A SPECIMEN
18¼ INCHES LONG.)

Google

dark olivaceous; middle of side with a broad pale rosy band from cheek to caudal fin; lower side dirty silvery; belly white with dirty wash; back and entire side closely covered with small roundish black spots, scarcely less numerous on middle and lower part of side to level of ventral than on back; spots covering top of head, 2 rows below eye, one spot on opercle, 6 on maxillary, and about 10 on tip of lower jaw; cheek and opercles rosy; lower part of head faint rosy, with dusky wash; vertical fins all thickly spotted; upper half of pectoral and ventral spotted; anal and ventral tipped anteriorly with white; dorsal and adipose dorsal slightly white-tipped; throat with slight yellowish wash; inside of mouth white.

Another example (a male 18 inches long), caught by one of our party in Kern River above the lake, had top of head, back, and entire side closely covered with small roundish black spots, similar spots covering vertical fins and some on pectorals and ventrals; cheek and opercles dark rosy, with a few black spots; general color dark olivaceous; side with moderately distinct rosy band.

This species is abundant in Kern Lake and in the river for several miles above the lake. It is probably common in the river for some miles below the lake, but of this I have no personal knowledge, as we did no collecting below the lake. As a rule, the fish taken from the river are more deeply and brightly colored and decidedly more game than those from the lake. During the spawning season early in the spring the fish are found chiefly in the river, but after the spawning has been completed they tend to run down into the lake, where they become less active and less highly colored. The large examples which we took in the lake were, as a rule, more slender than those from the river, probably on account of the fact that those from the lake were all spent fish.

This species is said by Jordan and Evermann[a] to reach a weight of 8 pounds, but I do not recall the authority upon which the statement was based. The largest example seen by us was the one upon which the above description is based. It was 18.25 inches long and weighed 3.5 pounds. Several other examples 14 to 19.25[b] inches long were caught by us. The largest individual of which I have a definite record was caught in 1900 in the river above the lake by Mr. E. D. Cox and weighed by Mr D. J. Cruice, both of Bakersfield, Cal. This fish was 27.5 inches long and weighed 5 pounds 14 ounces.

The Kern River trout is a beautiful fish, well built and symmetrical, and very rich in coloration when in prime condition. As a game fish it will stand easily among the best, but, as already stated, in the river it greatly excels those of its kind in the lake. It usually takes the fly quite freely, and will, of course, take all sorts of live or cut bait. Members of our party took these trout with the artificial fly, with grasshoppers (which they greatly preferred), and with pieces of fish or other meat. The large example painted was first tried with a gray hackle, to which he rose once and then paid no more attention to it. A larger, plain hook and a good-sized grasshopper were substituted, with better results. Scarcely had the lure touched the water when he rose and struck most viciously, only to miss it, then turn and strike again more viciously than before. This time the hook caught inside the mouth just under the middle of the maxillary, and then began a fight that would delight a better angler than I. He first circled about in a wide curve, then jumped twice, clearing the water beautifully each time; circled again, went to the bottom in water 10 feet deep, came to the surface and jumped again, after which no more leaps were made, but he continued dashing about until finally brought to net.

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[a] Fishes North and Middle America, p. 502.

[b] Although the longest fish caught by us, this was a slender individual weighing under 3 pounds.

Another good-sized example (2 pounds) was taken July 19 at the drift in the lower end of the lake. This fish was seen swimming slowly down the lake at a depth of about 3 feet. A cast brought a rise at once. Missing, he turned and came again, not with a rush, but deliberately, and took the lure. He pulled and tugged vigorously, rushed a bit, jumped once, shaking his head savagely, ran inshore then out again. Then I reeled him in, but three times he dashed away before I could use the landing net. This was the gamest fish caught in the lake, and was not much inferior to those taken in the river. Another large example caught in the lake July 20 broke water six times before coming to net, and was really very game.

Trout appear to be quite abundant in Kern River, but it is doubtful whether they will long remain so. During the few days we were at Kern Lake, six or seven other parties were camped at or near the lake, each party consisting of from two to ten people. One party of two, excellent anglers and true sportsmen, had been there for more than two months. They fished more or less every day, always with the fly, and usually threw back all they caught, especially the smaller ones. Another party of two were observed to go out upon the lake every day, tie their dugout to a snag, and devote the entire day to jerking out the trout. They kept it up day after day, and none was too small for their creel. On one occasion they were noticed to have at least 30 fish 6 to 12 inches long. And most of the other parties were doing about the same.

At this rate the trout can not long continue abundant in this stream. All fishing in the lake should be prohibited, the daily catch from the river should be limited to 10 fish per rod, and 8 inches should be the minimum legal size.

This species was named for Dr. Charles H. Gilbert, professor of zoology in Stanford University, who collected the type July 13, 1893, from Kern River at Soda Spring.

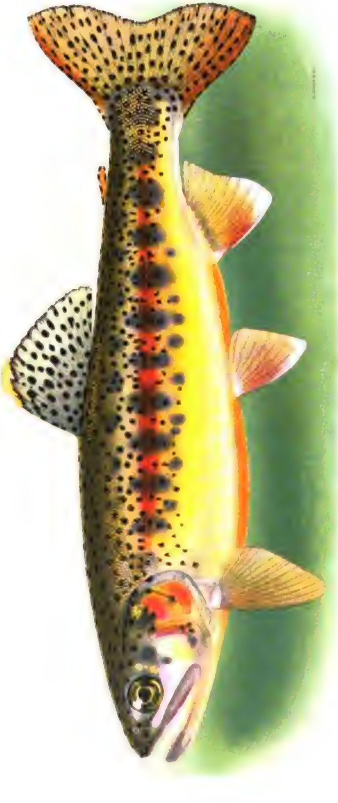
Salmo gairdneri gilberti Jordan, Thirteenth Biennial Report State Board Fish Commissioners California for 1893–94 (1894), p. 143, with plate.

Salmo irideus gilberti, Jordan & Evermann, Fishes North and Mid. Amer., 502, 1896. Jordan & Evermann, American Food and Game Fishes, 201, 1902.

7. **Salmo whitei** Evermann, new species. *Golden Trout of Soda Creek.*

(Plate XVI.)

Head 3.22 in length; depth 3.68; eye 4.54 in head; snout 3.33; maxillary 1.72; mandible 1.66; interorbital 3.57; longest dorsal ray 2.08; longest anal ray 2.17; pectoral 1.66; ventral 2.17; caudal lobes 1.61. Body rather stout, moderately compressed; head conic; mouth large, oblique, jaws subequal; maxillary long and slender, reaching much beyond the eye; teeth on jaws, tongue and palatines well developed; caudal peduncle deep, its least depth about equal to distance from tip of snout to middle of eye. Fins well developed; origin of dorsal somewhat nearer tip of snout than base of caudal fin; insertion of ventral about under middle of dorsal fin. Scales small, but noticeably larger than in the Volcano Creek trout.



GOLDEN TROUT OF SODA CREEK, SALMO WHITEI EVERMANN
(DRAWN FROM LIFE BY CHARLES B. HUDSON FROM THE
TYPE, A SPECIMEN 7⅞ INCHES LONG.)

Color in life, back and upper part of side light olive; side and back profusely covered with small roundish black spots, these extending on top of head, vertical fins, and on side below lateral line; side with 10 large roundish parr-marks and a broadish median band of light-brick or terra-cotta red; lower part of side light lemon-yellow with a number of bluish-black blotches, chiefly anteriorly, somewhat larger than similar ones on back; belly from tip of lower jaw to anal fin rich orange-red or cadmium, richest between pectoral and ventral fins, this band the full width of the belly; no red dash on throat; suborbital pale rosy or purplish; cheek brassy, with a large dark blotch; opercle rosy orange, olivaceous above; dorsal fin with about five rows of small round black spots and a black border except anteriorly, where the rays are tipped with a light-rosy border; pectoral light yellowish; ventral and anal reddish, with broad white edge; caudal profusely spotted with black like the dorsal fin.

In spirits all the bright colors have faded, but the black spots remain distinct. These spots are largest on the caudal peduncle, over which they are evenly distributed. They are also pretty evenly distributed over the entire side and top of head; the space along the lateral line, however, has fewer spots. Those below the lateral line extend more than halfway to the belly and are somewhat smaller than those above. About fourteen spots show on side of head.

There is not much variation in color, as shown by examination of many examples. In all, the black spots completely cover the caudal peduncle and the entire length of side from median line of back to some distance below the lateral line; the top and sides of the head are always spotted. The middle line of the side and the belly are always richly colored, the parr-marks always present, and the dorsal, anal, and ventral fins bright-edged. No conspicuous red dash was observed on the lower jaw in any of the specimens from South Fork of Kaweah, Soda Creek, or Wet Meadow Creek, but among those from Coyote Creek were some showing considerable color.

A cotype was described as follows: Back and top of head light brown with numerous small black spots extending on dorsal and caudal fins and on side distinctly to lateral line and below it less plainly, those on caudal peduncle largest and blackest; black spots also on top of head and halfway down sides on opercles and cheek; middle of side with a broad red or orange-red band extending from just behind base of pectoral to about middle of anal, broadest in middle portion; a large blotch of same color on opercle and some on cheek; thirteen distinct parr-marks on side, a row of smaller similar spots below; lower part of side light brown; a broad reddish or orange band along ventral line from throat to vent, the anterior part yellowish; dorsal fin covered with small black spots except anterior upper margin, which is light pink, whole distal edge, except the pink, margined with black, not quite continuous; pectoral olivaceous, with pink tinge, overlaid with dusky; ventrals same color as pectorals, but the pink more pronounced and the exterior distal edge white; anal same as ventral, bordered with white; caudal spotted like the dorsal, but no pink edge; adipose same as back, margin black, one spot on base.

In alcohol all of the specimens from South Fork Meadows are profusely covered with small, round, well-defined black spots on caudal peduncle, side, both above and below lateral line, and on top of head. The dorsal, anal, and ventral are light-edged in all. These specimens all seem to differ from South Fork of Kern specimens in the greater number of spots, and particularly in the presence of spots below the lateral line. They differ from the six specimens obtained in South Fork of Kaweah near Threerivers in having more spots below the lateral line and having the spots much more nearly round; besides, those from Threerivers in life were decidedly different in color, as shown by the life-color notes.

The collection contains 10 specimens from the South Fork of the Kaweah River at South Fork Meadows and 3 from Soda Creek at Quinns Horse Camp, about 5 miles distant. Besides these specimens, we examined perhaps 25 others from those two places. They range in length from 5.5 to 7.75 inches and are quite uniform in size. They show little or no more variation in color than is indicated by the preceding descriptions.

The collection also contains five specimens from Wet Meadow Creek, which are in some respects the finest that were obtained. They range in length from 7 to 9.75 inches and show some variation in spotting. The smallest two of these are more sparsely spotted than any of the others; nevertheless they show spots the full length of the side and some spots below the lateral line. The largest specimen (cotype No. 53398, U. S. N. M., 9.75 inches long) is rather more completely spotted than the type. The two other Wet Meadow Creek specimens (cotypes), although larger than the type, are spotted very much like it.

A large number of examples were examined from Little Kern, taken chiefly in the vicinity of Broder's cabin; of these, three were saved. They agree in all respects with those from South Fork Meadows.

Forty-four excellent specimens were obtained from Coyote Creek. These were taken at various places between the headwaters and the mouth of the stream. This creek has several falls which doubtless at present are barriers to the ascent of fish; nevertheless trout are found throughout the entire length of the stream, and are abundant immediately below and above each of the falls. Evidently the peopling of the entire stream was accomplished before the falls were formed or became impassable barriers. An examination of the large series of specimens shows them to be a very perplexing lot; the amount of variation among them is very great, and it is not without hesitation that I refer them all provisionally to *Salmo whitei*. In general they all agree essentially in being well spotted, although occasionally a specimen is seen with fewer spots below the lateral line. The spots, however, vary considerably in size; in some they are larger than in the South Fork Meadows fish, in others they are smaller; in many the spotting is more complete. In life some examples were quite dark in general coloration, and several showed red or yellow between the rami of the lower jaw. An effort was made to see whether these differences could be correlated in any way with different particular parts of the stream, and there is considerable evidence that such correlation can be made. It is believed that all the specimens taken between any two falls agree better among themselves than they do with those from any other portion of the stream, and it seems that we have here a number of differentiations now in progress which promise to become of taxonomic value. For the present these trout are all considered to be conspecific with those from South Fork Meadows and Soda Creek.

As stated elsewhere in this report, the headwaters of the South Fork of the Kaweah were originally without trout and were stocked with fish from Soda Creek at Quinns Horse Camp, and this species may therefore very properly be called the Soda Creek trout. It is known to reach a length of about 10 inches, takes the fly readily, and is a good fighter. Though less brilliantly colored than the golden trout of Volcano Creek, it is in every respect a beautiful and attractive fish.

Type, No. 53065, U.S.N.M, a specimen 7.75 inches long, taken in the South Fork of Kaweah River in South Fork Meadows, by the writer, July 15, 1904. Cotypes: No. 53399, U.S.N.M., 7.25 and 7.5 inches long; No. 1252, Bureau of Fisheries, 6.5 inches long; and No. 9254, Stanford University, 6.25 inches long.

I am pleased to name this beautiful trout for Stewart Edward White, author of The Blazed Trail.

8. **Salmo agua-bonita** (Jordan). *Golden Trout of South Fork of Kern River.*

Head 3.68 in length; depth 3.85; eye 4.4 in head; snout 4.4; maxillary 2.09; mandible 2.00; interorbital 3.66; longest dorsal ray 2.09; base of dorsal 1.8; longest anal ray 1.69, pectoral 1.63; ventral 2.00; caudal lobes 1.46; base of anal 2.1. Body stout, moderately elongate; head short, snout blunt; mouth moderate, maxillary extending somewhat beyond orbit, relatively broader than in the Kern River trout; teeth on jaws, maxillary, palatines, and vomer well developed; fins moderate; caudal peduncle compressed, its least depth equal to distance from tip of snout to posterior edge of pupil; scales relatively large.

Color in life, back and upper part of side light olivaceous; entire body above lateral line, including head, sparsely covered with rather large roundish black spots, these extending below lateral line on caudal peduncle; spots on side anterior to dorsal fin usually few; usually a few spots on median line of back between origin of dorsal and head; snout and top of head usually with a few spots; 2 or 3 spots sometimes on side of head; middle of side with a somewhat distinct rosy band, plainest at middle; parr-marks always present; side below lateral line light golden yellow; belly scarlet, brightest from ventral halfway to isthmus; under side of head, except jaw, reddish orange; cheek light golden yellow anteriorly, rosy or coppery posteriorly; dorsal and anal fins profusely spotted, the other fins with no spots, the anal dusky; adipose fin with edge black, and 2 small black spots; anterior dorsal rays tipped with reddish orange; ventrals and anal red, tipped with orange white; pectoral bronze. The above description chiefly from a specimen 7.75 inches long.

Another example 8.5 inches long was dark olivaceous above, had few spots in front of anal fin, and those mostly posterior to anterior base of dorsal fin; a few spots on top of head; caudal peduncle with numerous spots, both above and below lateral line; parr-marks large and distinct, 11 in number, a few small detached spots similar in color below them, and 1 to 3 such spots on side of head; lateral band rather indistinct, of a brick-red color, extending from middle of anal fin to about midway between front of dorsal and head; side below lateral band light golden yellow; belly reddish from throat to anterior edge of anal fin, the triangle just behind isthmus bounded by whitish; branchiostegal region rich orange; lower jaw greenish yellow (the stipple marks greenish); opercle and preopercle with a coppery tinge; anterior portion of cheek light golden yellow; dorsal and caudal fins with numerous black spots; adipose dorsal edged with black and with 3 round black spots; other fins immaculate; anterior rays of dorsal and anal and outer rays of ventrals with whitish orange tips; pectoral bronze; ventrals reddish; anal greenish bronze.

An examination of numerous examples shows some slight variations in the colors. The parr-marks are sometimes less regular, and the exact shade of the bright lateral band and the color of the belly vary somewhat. These, however, are simply differences in intensity rather than in pattern. The extent of the spotting on the body is the best diagnostic character. The South Fork of Kern trout are almost invariably well spotted, not only on the caudal peduncle but also along the side above the lateral line, at least as far forward as the front of the dorsal fin. There are also usually a few spots on the anterior part of side and along median line of back between dorsal and head; snout and top of head spotted, and usually a few spots on side of head; but there are no spots below the lateral line except on the caudal peduncle.

The type and a cotype of this species, which I have examined in the National Museum, consist of two specimens 7 and 8 inches long, respectively. The larger specimen is in rather bad condition and shows no spots distinctly except on the caudal peduncle. The other and better specimen shows plainly a number of spots along the side above the lateral line, even to the gill-opening. A colored sketch of the specimen which Dr. Jordan took as the type has been kindly loaned to me by Dr. C. H. Gilbert. The drawing is by E. L. Ames and is labeled "Type of *Salmo agua-bonita*" in Dr. Gilbert's writing. This drawing shows a number of spots along the side above the lateral line even forward to the gill-opening, and was evidently made from the smaller and better preserved specimen in the National Museum. This specimen is therefore certainly the one which Dr. Jordan took as his type of the species and agrees very closely with the majority of the large series (39 examples) of specimens in my collection. Of my 39 specimens all but 5 are more or less profusely spotted above the lateral line along the entire length of the side and on top of head and snout.

In the National Museum are 2 specimens (No. 46120), collected in Cottonwood Creek (into which the species was introduced from South Fork of Kern) September 12, 1891, by Basil Hicks Dutcher for the Biological Survey, Department of Agriculture. These specimens are 6.5 and 7 inches long. The smaller one still shows a number of dark spots along side above the lateral line at least as far forward as the beginning of the dorsal. In the other the spots have faded and are not distinct except on the caudal peduncle. Two other specimens (No. 46121) are in the National Museum, collected in 1891 by Mr. F. Stephens, also for the Biological Survey, in the South Fork of the Kern at about 6,500 feet altitude. They are 4.5 and 6.25 inches long, and each is profusely spotted above the lateral line for entire length of body and on snout and top of head.

The first record of trout from this portion of the Sierras is that by Jordan and Henshaw in the Report of the Chief of Engineers of the Army, for 1878. In this report a single specimen (No. 17107, U. S. Nat. Mus.) is recorded. It was caught in 1875 by Mr. H. W. Henshaw from the South Fork of Kern River, Kern County, Cal., and was identified as *Salmo irideus*.

Not until seventeen years later did other specimens from this locality come into the hands of any ichthyologist. In 1892 Dr. David S. Jordan received three small trout from Mr. W. H. Shockley, of San Francisco, to whom they had been sent by

Mr. George T. Mills, state fish commissioner of Nevada, who had received them from Mr. A. C. Harvey, of Lone Pine, Inyo County, Cal. The memorandum accompanying the specimens when they came into Dr. Jordan's possession was to the effect that the fish had been "taken by Mr. Harvey, of Lone Pine, Cal., in a stream called by him 'Whitney Creek' (more correctly Volcano Creek), on the west side of the Sierras near Mount Whitney." Dr. Jordan described these specimens as a new subspecies under the name *Salmo mykiss agua-bonita* in the Proceedings of the U. S. National Museum for 1892[a], page 481.

In 1891 members of the Death Valley Expedition of the U. S. Biological Survey collected a number of trout in this region, as follows: Mr. Vernon Bailey, 2 specimens from Volcano Creek in Whitney (Volcano) Meadows; Mr. F. Stevens, 2 specimens from South Fork of Kern River, and Mr. B. H. Dutcher, 2 specimens from Cottonwood Creek. These were examined by Dr. Chas. H. Gilbert, who reported on them in North American Fauna No. 7 as *Salmo mykiss agua-bonita*.

In the summer of 1893 Dr. Gilbert visited the Kern River region and obtained specimens of trout from Kern River at Soda Spring and from Volcano Creek. The former were described by Dr. Jordan in 1894 as *Salmo gairdneri gilberti*.[b]

It has since developed that the specimens sent to Dr. Jordan by Mr. Shockley, and upon which Dr. Jordan based his description of *Salmo mykiss agua-bonita*, did not come from Whitney (Volcano) Creek, but from Cottonwood Creek; they are therefore identical with the trout of the South Fork of the Kern, from which came the original stock of Cottonwood Creek.

Trout seem to be abundant in the South Fork of the Kern. On July 23, in a few minutes at the tunnel I caught 8 good examples, 5 to 7.5 inches long. The collection contains a total of 40 specimens from 4 to 8 inches in length. The game qualities of these trout are good. They take the fly readily, and for their size make a good fight. They can apparently be taken at any time of day and with any sort of lure. How far down the South Fork of the Kern they are found is not known, but it is likely they occur well toward the mouth of that stream. They probably do not attain a greater weight than one or two pounds in the South Fork, but it is said they reach a much greater size in the Cottonwood Lakes. I have been told that trout weighing 5 pounds have been caught in those lakes, but this needs verification.

Professor Henshaw gives the following very interesting account of the habits of this trout as observed by him in 1875:

> In the tributaries of the South Fork of the Kern River these trout are found in very great abundance, each pool and rapid numbering its finny denizens by the score. They may be taken in any sort of weather, at any hour of the day, by almost any kind of bait. During the heat of the day they frequent almost entirely the deeper pools, lying under overshadowing rocks or in the shade of some convenient log. In early morning or late afternoon they come out and run more into the shallows and rapids, under which circumstances they bite best and afford the finest sport. Like the average brook trout, the species rarely attains any considerable size, ranging from 4 to 8 or more inches in length. Their colors are usually very bright, and for beauty this species takes rank among the foremost of its kind and has been well called the "golden trout." In this respect, however, it is subject to the usual variation obtaining in the family, the change of color not only accompanying a difference in locality, but being plainly discernible in individuals taken in different parts of the same

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[a] Actual date of publication July 24, 1893.

[b] Thirteenth Biennial Rept. Fish Comm. Cal., 1894, p. 143, with plate.

stream not far distant. In fact, as a specific character, color in this family seems to be at its lowest value.

The character of the bottom and water itself has much to do with this, and I remember to have fished in a small rivulet on one of the subalpine meadows not far from Mount Whitney, whose sluggish waters flowed over a bottom of dark mud, in which the color of the trout simulated very closely its hue; they had lost nearly all the flashing iridescent tints characterizing the same species caught but a few hours before in another stream, and had become dull and somber-hued. Accompanying this change of color was a correspondingly noticeable difference in habits and motions, and the several dozen trout caught that evening for supper were taken out by the hook with the display of very little more gameness than would be noticed in so many horned pout. On the contrary, in the clear, rapid current of the mountain stream a flash of sunlight is scarcely quicker than the gleam of gold and silver seen for a single instant as the whirling waters are cut by one of these trout as he makes a rush from his lurking place for some chance morsel which is being borne past him. The western trout are rarely as shy as their relatives of eastern waters, and because of their numbers and the consequent scarcity of food are apt to be less fastidious; yet, even when most abundant, due caution must be used if one would be successful, and not every one can catch trout, even in the West. With the proper care in concealing oneself, a pool may be almost decimated ere the alarm will be taken, and I have seen 15 fair-sized trout taken from a single small pool in quick succession.

The species was named for Agua-Bonita Falls in Volcano Creek, under the erroneous supposition that the type came from that creek.

Salmo mykiss agua-bonita Jordan, Proc. U. S. Nat. Mus., XV, 1892 (July 24, 1893), 481, Cottonwood Creek, Inyo County, Cal. Gilbert, North Amer. Fauna, No. 7, 232, May 31, 1893.

Salmo irideus agua-bonita, Jordan & Evermann, Fishes North and Mid. Amer., I, 503, 1896 (Oct. 3).

Salmo agua-bonita, Jordan & Evermann, American Food and Game Fishes, 201, 1902.

9. **Salmo roosevelti** Evermann, new species.

Golden Trout of Volcano Creek; Roosevelt Trout.

(Plate I.)

Head 3.5 in length to base of caudal fin; depth 4; eye 5.6 in head; snout 3.4; maxillary 1.8; mandible 1.5; interorbital 3.79; D. 11; A. 11; longest dorsal ray 1.8; longest anal ray 1.9; pectoral 1.8; ventral 2.1; caudal lobes 1.8; base of dorsal 1.9; base of anal 2.6; least depth of caudal peduncle 2.6. Body stout, moderately compressed; head conic, rather long; snout long; jaws subequal, mouth large, somewhat oblique; maxillary long and narrow but slightly curved, extending much beyond orbit; teeth well developed on mandible, maxillary, palatines, front of vomer, and on front of tongue, the latter in two rows; caudal peduncle very stout. Fins all strong and well developed; origin of dorsal midway between tip of snout and base of caudal peduncle; base of ventrals under middle of dorsal; caudal broad, strong, little notched when fully spread; anal with its free edge somewhat falcate. Scales exceedingly small, smaller than in any other known species of trout, nonimbricated, and scarcely showing unless dry; there are about 50 in an oblique series from front of dorsal downward and backward to lateral line, and 40 from the lateral line downward and backward to the base of the ventrals; there are about 200 scales in the lateral line, 140 to 150 of them having pores.

Color in life, back, top of head, and upper part of side very light yellowish olive; middle of the side from gill-opening to adipose fin with a broad bright rosy band, the greatest width of which is about equal to greatest diameter of orbit; side below lateral line bright golden yellow, fading below into yellowish white; belly with a broad cadmium or deep orange-red band from throat to anal fin, the color deepest between pectoral and ventral; some red on belly between origin of anal and base of caudal; about 10 roundish or vertically oblong parr-marks on middle of side, upon which apparently the rosy lateral band is superimposed; 3 of these parr-marks are on the caudal peduncle posterior to the adipose fin, 2 between the adipose and dorsal fins, 2 under the dorsal, and 3 anterior to it; between the first and second large parr-marks and somewhat below them is a small round spot of the same color, and there is a similar one between the fifth and sixth spots; cheek and opercles bright rosy, edged posteriorly and below with yellowish, an olivaceous blotch on upper part of cheek and a small black spot on upper part of opercle; region about eye olivaceous yellow, especially below; lower jaw rosy, with some yellowish, membrane between rami of lower jaw whitish, without rosy wash, tip of lower jaw olivaceous; mouth on sides and below tongue orange, whitish elsewhere; side of caudal peduncle with about 30 small roundish black spots, these most numerous on posterior half, there being only 3 anterior to the adipose dorsal fin; rest of body entirely without spots; dorsal fin with about 6 irregular series of small roundish black spots, those toward the distal portion largest and blackest; general color of dorsal fin light olivaceous yellow, the tips of the anterior rays with a broad margin of whitish orange; adipose dorsal olivaceous, narrowly bordered with black, and with 2 small round black spots; caudal fin profusely spotted with black, the spots arranged irregularly in about 8 or 10 vertical rows; those at the base blackest and roundest, those on the distal edge somewhat linear, those on the outer edges of the lobes extending forward onto the dorsal and ventral lines of the caudal peduncle; general color of caudal fin yellowish and olivaceous, the lower lobe somewhat rosy; pectoral red, somewhat lighter than lateral band; ventral reddish, the anterior rays edged with white; anal reddish with a little orange, the anterior half or two-thirds broadly edged with white.

There is not much variation in color, except such as is probably due to difference in age; the rosy lateral band, the parr-marks, and the broad rich cadmium band on the belly are characteristic. The variation in the black spots is inconsiderable. In the 29 specimens which I have examined critically 15 do not show any spots whatever anterior to the adipose fin, and only 2 of the remaining 14 show any spots anterior to the dorsal fin, and these are obscure and few in number. In one large specimen there are but 12 to 14 spots on the caudal peduncle; in another somewhat smaller example there are but 6 spots. The dorsal, anal, and ventral fins are invariably edged with brighter color. The head in the males is longer and more pointed; the maxillary is also longer than in the females. When well spread the caudal fin is usually slightly lunate or slightly notched, but in some examples it is almost truncate or square. In alcohol all of the bright colors soon fade, the parr-marks, black spots, and pale edges to the dorsal, anal, and ventral fins persisting. The general color of the body then becomes a dirty yellowish white or in some specimens brownish. In some cases the parr-marks almost wholly disappear.

The type specimen of this species is No. 53064, U. S. Nat. Mus. Cotypes are No. 53400, U. S. Nat. Mus., No. 1251, Bureau of Fisheries, and No. 9255, Stanford University. It gives me great pleasure to name this superb trout for Theodore Roosevelt, in recognition of his active interest in fish and game protection.

This is the most beautiful of all the trouts; the brilliancy and richness of its coloration is not equaled in any other known species; the delicate golden olive of the head, back, and upper part of the side, the clear golden yellow along and below the lateral line, and the marvelously rich cadmium of the under parts fully entitle this species to be known above all others as *the* golden trout. In form it is no less beautiful; its lines are perfect, the fins large and well proportioned, and the caudal peduncle strong; all fitting it admirably for life in the turbulent waters in which it dwells. It is a small fish, however. The largest example collected by us was 11¼ inches in total length and the heaviest one weighed 10 ounces. It is probable that it never attains a greater length than 14 inches or a weight of more than a pound in Volcano Creek.

The golden trout is native to Volcano Creek alone, and occurs throughout the entire length of that stream. We caught specimens at various places from above the tunnel to below the lowermost of the series of falls near the mouth, and it was seen in all suitable places from the tunnel to the headwaters above Volcano Meadows, where the elevation is more than 10,000 feet. Although the fish runs down Volcano Creek even to below the lowest falls, it apparently does not venture out into Kern River; no examples were seen there. It is a creek fish and appears to keep within the peculiar environment of the small stream. Although we obtained a specimen at the foot of the first falls, it is doubtful whether many individuals venture so far down.

Trout are abundant in Volcano Creek; every pool at the foot of a fall or below a cascade or rapid was sure to contain a number of them, and others were seen on the riffles and under the protecting banks. They were most numerous above the tunnel, probably because fewer tourists visit that portion of the stream. The fish there, however, were usually small. The largest, finest examples were seen between the natural bridge and the lower falls.

As a game fish the golden trout is one of the best. It will rise to any kind of lure, including the artificial fly, and at any time of day. A No. 10 fly is large enough, perhaps too large; No. 12 or even smaller is much better. In the morning and again in the evening it would take the fly with a rush and make a good fight, jumping frequently when permitted to do so; during the middle of the day it rose more deliberately and could sometimes be tempted only with grasshoppers. It is a fish that does not give up soon but continues the fight. Its unusual breadth of fins and strength of caudal peduncle, together with the turbulent water in which it dwells, enable it to make a fight equaling that offered by many a larger trout.

Although now abundant the golden trout can not long remain so unless afforded some protection. The attractiveness of the Kern River region because of its scenic beauty is sure to appeal more and more to tourists every year. Practically the entire length of Volcano Creek is easily accessible from the trail from Kern River to Mount Whitney, and that portion above the tunnel is covered by the trail from the east side of the divide. As a matter of fact one can in one day travel the entire length of the creek and have time to stop frequently to drop a fly into the pools which he passes. The trout are readily found and are easily captured, as they are so voracious and rise to the lure so readily. Two years ago the members of the Sierra Club and others accompanying them on their annual outing to Mount Whitney are said to have taken 600 or 700 trout from Volcano Creek in one day.[a] During the time our party was on Volcano Creek three to five other parties were camping at different places along its course. Each of those parties contained two to ten persons, and they all depended chiefly on the creek for their meat. How many trout were taken daily there is no means of knowing, but the number must have been very large. One party of three acknowledged that they ate 65 one day for supper.

RECOMMENDATIONS FOR THE PROTECTION OF THE GOLDEN TROUT.

Provision for the protection and preservation of the golden trout should proceed along two lines, viz: Through fish-cultural operations and by imposing restrictions on its capture.

Artificial propagation.—The golden trout is a hardy fish and stands transportation well, as shown by the following statement of Mr. Chas. A. Vogelsang, chief deputy of the California fish commission:[b]

> Some years ago J. Sub Johnson, of Visalia, brought down some specimens of golden trout, but not being thoroughly familiar with the best methods to follow in transporting them he lost about four-fifths of the number. The remainder were placed in our Sisson hatchery, where we kept them for probably eight months, and where we expected to take spawn from them, but an accident to our water supply cost us these fish. We hope this coming summer to send one of our experienced men into the Whitney Creek region to collect as many four-inch to six-inch trout as we can, transport them to Sisson, and place them in our hatchery ponds to be used as breeders.

In the spring of 1905 Mr. Earl L. Morris, of Stanford University, visited Cottonwood Creek and caught with hook and line and seine 50 trout, which he took without loss to San Francisco, where they were exhibited for several weeks at the Exposition of the Pacific Fish and Game Association. They were then transferred without a fatality to the Sisson hatchery, where they will be propagated by the California fish commission. This is the South Fork of Kern trout, but it is probably no more hardy than the Volcano Creek species.

In May, 1905, the United States Bureau of Fisheries attempted to establish a temporary station on Volcano Creek for the purpose of taking the eggs of the golden trout. It was found that the spawning season was practically over before the station could be installed, and the matter was postponed temporarily. A number of fish (264) were captured, however, and carried practically without loss on pack animals to Lone Pine, whence they were shipped in care of a special messenger to the Lewis and Clark Exposition at Portland. Through a mishap, however, the entire lot was lost en route.

Although the efforts thus far made have not proved successful, it is not believed that any real difficulties exist to prevent the carrying of trout from Volcano Creek to one or more of the trout hatcheries of the Bureau, and it is hoped that another effort may soon be made. If a number of fish can once be gotten to one of the hatcheries it will be easy to propagate the species artificially.

There are many small mountain streams in the Western States where this fish would certainly thrive. It should also be tried in certain streams in the East. A small, clear stream, with low temperature and fine gravelly bottom, preferably of granite, is recommended. It would be extremely interesting to try the species in several streams and note the effects of the new environment. The possibility of adding such an attractive fish to the streams of other states is well worth a serious effort. It is also desirable to establish a temporary hatchery on Volcano Creek where eggs may be taken and eyed for shipment.

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[a] Mount Whitney Club Journal, Vol. 1, No. 3, May, 1904, p. 115.

[b] In a letter to Mr. John Brosler, dated November 30, 1904.

Another thing that should be taken up at once, preferably by the California fish commission, is the stocking of barren waters in the Kern River region. As stated elsewhere in this report, there are many small streams and lakes of the southern High Sierras that are entirely without fish of any kind, although certainly well suited to trout. Among these may be mentioned Rock Creek, Guyot Creek, Whitney Creek and the lakes at its head, and many others. To stock these waters by transplanting from Volcano Creek would be a very easy matter.

Protection. As already stated, it is only a question of time, a very few years at most, when the golden trout of Volcano Creek will become practically exterminated unless it receives some protection.

In order that adequate protection be secured, it is recommended that the limits of the Mount Whitney Military Reservation be extended so as to include the whole of Volcano Creek. This can be done by extending the eastern boundary from the present southern boundary along the meridian of 118° 10′ to its intersection with the parallel of 36° 20′, thence west on that parallel to Kern River, which should be made the western boundary. The northern boundary should be extended westward to the main fork of Kern River. This would include all of Volcano Creek, the headwaters of Cottonwood Creek, and South Fork of the Kern, as well as all of Rock Creek and Whitney Creek. When the boundaries have been thus extended, fishing within the limits of the reservation should be absolutely prohibited for three years, after which it might be permitted under certain restrictions. These restrictions should provide a minimum size, limit the number that may be caught, and prohibit all fishing during the spawning season.

With such regulations as these, together with the fish-cultural operations suggested, it is believed the golden trout will continue an abundant fish and remain one of the great attractions of this interesting region.

10. **Salmo shasta** Jordan. *Shasta Trout; Rainbow Trout.*

This is the common rainbow trout of fish culturists, which has been introduced into many different waters in southern California. Specimens of a trout which we provisionally identify with this species were obtained at the following places: South Fork of Kaweah River 4 miles above Threerivers, and at Alles's ranch about 4 miles farther up; Middle Fork of Tule River in its headwaters; Middle Fork of Kaweah River just below the new power house, or about 1.5 miles below the mouth of the East Fork; and in Marble Fork of Kaweah above the bridge on the road to the Giant Forest.

The following life-color notes were made by Dr. Jenkins on specimens obtained by him from Marble Fork:

Specimen F: Dark olivaceous above to white on belly; no sign of color band on belly; color band on side brick red, narrow, brightest in center of body and indistinct at the extremities; opercle and preöpercle indistinct reddish, also marks on throat light yellowish, not conspicuous; body covered with many rather large spots which extend nearly to belly; dorsal with dark spots irregularly placed; tips of about first 6 rays yellowish white; caudal spotted irregularly; pectoral dusky, with outer portions showing yellow; ventrals pinkish, with anterior margin white; anal reddish, tips of about 5 anterior rays white.

Specimen G: Like preceding, except much lighter in general color; color band very faint; marks on throat almost obsolete; pectoral pale yellowish; ventrals pinkish with white tips; anal dusky, faint pink, with margin of white; spots on dorsal slight, show of white on tips.

Specimen H: Similar to preceding in lightness of color, being light gray; spots on body, top, and sides numerous and distinct; color band on side of body and color on opercles very indistinct; throat mark not distinguishable.

Specimen I: Light gray spots numerous, small—few below lateral line; reddish band, throat marks, and color on opercles distinct; fins as in the preceding.

Specimen J: Light gray, passing to white on lower sides and belly; reddish band evident, but indistinct in extent; reddish on opercles; throat marks conspicuous, reddish orange; no spots on body; spots on dorsal, but few on caudal; pectoral faint yellowish; ventrals pinkish with white tips; anal faintly dusky with white tips.

Specimen K: Similar to above, but with few spots.

Six examples taken from the South Fork above Threerivers were in alcohol profusely spotted on the caudal peduncle, on side above lateral line, and usually on top of head with small irregular stellate black spots, quite different in shape from those found on the trout from South Fork Meadows. The Threerivers trout also seem to have a shorter head. Their life color was quite different, being much less brilliant.

An example caught at Alles's ranch showed side with a broad red or rosy band; opercle rosy; back and side above lateral line profusely and closely spotted; few spots on side below lateral line; nine parr-marks; dorsal with many round black spots, the anterior edge of fin rosy; pectoral yellowish; ventral and anal dull red, edged with white; no red on throat. Twelve other trout were obtained at this place. They ranged in length from 5.5 to 8 inches and agreed essentially in colors. Most of them were somewhat silvery, but all showed the rosy lateral band, the parr-marks, and the white or yellowish tips to the dorsal, anal, and ventral fins.

Examples taken by Professor Green in Middle Tule were described as follows: Back dark olivaceous or bluish; back and side covered with rather large roundish black spots, few and small in front of dorsal; spots on side extending to belly on nearly all; median line of side with a narrow band of light brick-red (not so bright nor so wide as in Soda Creek fish) from middle of pectoral to middle of anal, sometimes farther back; cheek with dusky brassy; opercle red above, paler below, with dusky wash; belly white, sometimes dirty white, no orange or red; pectoral yellowish; ventral dusky yellow, edged with white; dorsal same as back, with 3 or 4 rows of spots, anterior distal edge creamy white with some orange; margin black; caudal with fewer spots than South Fork of Kaweah trout; anal pale, with a few small spots on base; white-edged; adipose fin margined with black.

Another example 8.25 inches long was described as follows: Spots on caudal same as dorsal; no red on lower jaw; blotches of immature trout plain; anterior half of dorsal edged with yellowish white; first ray and tips of 3 or 4 anterior rays of fins margined with white; pectoral yellowish; anterior half of ventral and anal fins reddish; adipose fin margined with black; side not silvery except in small individuals, but irregularly blotched with color similar to immature markings; lateral band not continuous, but broken by blotches on immature example and not extending to caudal or to cheek; color of band light brick red, lighter red on cheeks.

In alcohol these trout closely resemble those from South Fork Meadows. The spots, however, appear to be rather larger and less regular in form. They differ from the Threerivers trout in being decidedly more spotted below the lateral line; the spots, however, are of the same shape in these two groups. In life these Tule trout resembled the South Fork Meadow trout in their bright coloration, but it was noticed then that the black spots were different in shape. The 9 examples caught in Middle Tule ranged from 5.75 to 9 inches in total length, and closely resemble those taken in Middle Fork of Kaweah above Threerivers.

11. **Salmo clarkii** Richardson. *Cut-throat Trout.*

Four specimens obtained from Marble Fork, one-half mile above the bridge on the road to the Giant Forest, are evidently introduced fish and are referred to the above species. The following color notes are furnished by Dr. Jenkins:

Specimen B: Length, 12.25 inches. Body dark, olivaceous dusky; belly dirty white, with a show of yellow in places; sides dull coppery red, no distinct band; lower part of side yellowish; opercle and preopercle dull coppery red; few spots on the anterior part of body, these few being confined to top of head, a very few in front of dorsal; spots on caudal peduncle and in the space between the adipose and dorsal fins; dorsal with 4 or 5 rows of spots with a black outer margin, no white tips; caudal with about 5 transverse rows of black spots; pectorals, ventrals, and anal dusky; anterior tips of ventrals white; conspicuous coppery orange band on each side of throat (cut-throat mark).

Specimen C: In comparison with above, general color lighter, the reddish color of sides indistinct and narrow; sides of head indistinct reddish; bands on throat conspicuous orange; spots on body much more numerous, extending from dorsal to tip of snout; a few on the sides; fins like the preceding.

Specimen D: Lighter than C, otherwise similar, except that reddish color on sides of head is more noticeable; marks present on throat, but not so conspicuous as in C.

Specimen E: Similar to D, marking on throat conspicuous.

INTRODUCTION OF TROUT INTO STREAMS OF THE SOUTHERN HIGH SIERRAS.

During the last twenty-five or thirty years commendable interest and activity have been shown by the citizens of Tulare County in conserving the supply of food and game fishes of their portion of the state. This activity has manifested itself in securing consignments of trout and other species from the state and federal governments and in transplanting native trout to barren waters. This excellent work has been brought about through various agencies. In the first place, a rancher, observing that certain streams, apparently well suited to trout, were wholly without fishes of any kind, would undertake to stock the barren stream by transplanting trout from some near-by waters. The equipment for the work, though usually quite primitive—probably consisting merely of a tin can, a coffeepot, or bucket—was often adequate, and the transplanting was successfully accomplished. Mr. John Broder, of Redstone Park, has been very active in stocking barren waters of this region, and he informs me that to his knowledge the following streams have been stocked with trout in recent years: East Fork of Kaweah throughout its entire length and including several of the small tributaries at its headwaters; Cliff Creek, tributary to Middle Fork of Kaweah, just north of Mineral King; Wolverton Creek, tributary to Marble Fork of Kaweah at north edge of the Giant Forest; Big Arroyo, tributary to Kern River, stocked by Edward Hurlburt from the Little Kern; Rattlesnake Creek, tributary to Kern River, stocked by Mr. Broder from the Little Kern, the result not known; Shotgun Creek, one of the headwaters of the Little Kern; Nine Mile Creek, an eastern tributary of Kern River which it joins below Kern Lake, was stocked from Kern River in 1897 by Mr. Broder near the Hot Springs; South Fork of Kaweah at South Fork Meadows south of Sand Meadow with trout from Soda Creek at Quinns Horse Camp.

The history of the introduction of trout into Cottonwood Creek and the subsequent description of the species is interesting and should be made a matter of record. Cottonwood Creek was originally without trout of any kind. Desiring to learn the facts concerning the introduction of the fish into this stream I interviewed or wrote to a number of gentlemen who were supposed to possess information bearing upon the transaction. In response to my letters several replies were received. Judge A. C. Harvey, of Lone Pine, Inyo County, Cal., gave a full account of the transplanting. He says:

> The golden trout were caught in South Fork of Kern River in a little stream in Mulky Meadow, just where the Hockett trail enters the meadow. They were caught with hook and line by S. V. Stevens, A. C. Stevens, and Thomas George. Thirteen fish were caught and carried in a coffee pot over the Hockett trail and put in Cottonwood Creek about a mile above the Stevens sawmill, at a place known as the "Tom Williams bridge." One died in transit. This was, I think, in July, 1876. The distance from the place in Mulky Meadow where the fish were obtained to the Tom Williams bridge is about 3½ to 4 miles. There was no possible way for fish from Volcano Creek to get into the waters of Mulky Meadow at that time. I have heard lately that fish from Volcano Creek had been put in Cottonwood Creek many years before by a man by the name of Nelson; if so, they did not live, for I have fished in these mountain streams since 1870. In 1879 Mr. Stevens and I took a nice string of fish from Cottonwood Creek, which showed that they did well; they would average about 8 inches long. I am positive no fish were ever put in from Kings River, as has been claimed by some. In 1890 (1891) Mr. E. H. Edwards, M. Hand, J. R. Moffet, and a man named Cook turned a little stream of the Cottonwood Creek and caught perhaps 100 fish and took them about 2½ miles up to Cottonwood Lakes. When they arrived at the lakes quite a number of the fish were dead. Perhaps 50 lived and apparently have done well. They grow very large in the lakes; some have been taken that weigh over 5 pounds. They are beauties and very fat, but our fish law does not quite fit the requirements of the golden trout. A great many fish are taken on the riffles between the lakes in May and June, at the height of the spawning season, which should not be done. The altitude of the lakes is about 10,000 feet, which makes their season short. They are very prolific. I have taken them in the latter part of August with spawn.

Mr. George W. Stewart, president of the Tulare County Fish and Game League, gives the following information under date of October 28, 1904:

> I have been informed and have for several years been under the impression that Mr. E. H. Edwards, of Lone Pine, Inyo County, Cal., had planted golden trout in Cottonwood Creek. I recently wrote him for full information concerning the matter—the date and places where planted and the stream from which the fish planted were procured. I am in receipt of the following from Mr. Edwards: "Cottonwood Creek was stocked by Colonel Stevens, Thomas George, and A. C. Stevens in 1876 with

> fish brought from Mulky Creek, a branch of the South Fork of Kern River, which runs through Mulky Meadows. The two lakes above the falls at the North Fork of Cottonwood Creek were stocked fourteen years ago (in 1891) by M. P. Hand, E. H. Edwards, Manuel Silva, James Moffett, and a member of a government scientific expedition[a] that was here at that time. These fish were taken from a small tributary of Cottonwood Creek below the falls."

These two accounts agree perfectly in all essential respects, and it may therefore be regarded as established that Cottonwood Creek was stocked in 1876 by Messrs. A. C. Stevens, S. V. Stevens, and Thomas George with trout (*Salmo agua-bonita*) from Mulky Creek, a small tributary of the South Fork of the Kern; that the Cottonwood lakes were stocked in 1891 by Messrs. M. P. Hand, E. H. Edwards, Manuel Silva, James Moffett, and B. H. Dutcher with trout from Cottonwood Creek; and that no other plants have been made in that creek or its branches.

Nelson Creek, a small tributary of Middle Fork of Tule River, was stocked in 1897 or 1898 by Mr. J. M. Nelson, of Daunt, Tulare County, with trout from Volcano Creek. Mr. Nelson started with 22 fish, 4 of which died on the way. The remaining 18 were successfully planted in Nelson Creek, and trout are said to be abundant in that stream now.

Unfortunately the data regarding many of these fish-cultural operations are not wholly complete. In a number of cases the date when the plant was made, the names of the parties making it, the exact place where the fish were planted, and, most unfortunately, the name of the stream from which the stock was obtained have not been recorded. It is particularly regrettable that the names of the streams from which the trout were obtained and of those in which they were placed were not made a matter of careful record.

Later, rod and gun clubs were organized in various towns and villages, and these were and are instrumental in securing consignments of fish from the state and federal fish commissions.

Mr. Stewart and Mr. Broder have furnished very full accounts of the planting and transplanting that has been done in the region drained by the Kings, Kaweah, and Kern rivers. According to Mr. Stewart:

> Before the work of planting was begun by the people of Tulare County there was not a trout between Kings River and the South Fork of the Kaweah River, in the upper altitudes of the Sierra, and probably the same was true of the upper waters of Tule River, Deer Creek, and White River. These streams are all on the western slope of the range. The first planting of fish of any kind done in Tulare County was about twenty-five years ago, when a planting of whitefish and Eastern catfish, secured from the U. S. Fish Commission, was made in the waters of Tulare Lake, then a shallow body of water 30 miles long and 18 or 20 wide. The waters being somewhat alkaline the whitefish soon died, but the catfish thrived and soon populated all the streams then emptying into the lake. This lake, from which large quantities of fish, mainly perch, were formerly supplied to the San Francisco market, has almost ceased to exist on account of the diversion of the water from the streams once feeding it for the purposes of irrigation, and sometimes in the latter part of summer disappears entirely.
>
> Perch are still to be found in lower Kings River and adjacent sloughs. The large cyprinoid, *Mylopharodon conocephalus*, locally called "lake fish" or "lake trout," which formerly ascended the streams into the foothills during high water, are still found in small numbers in the deep pools of the Kaweah and Tule rivers. At that time (twenty-five years ago) carp were introduced into this country. They were kept in ponds at first, but escaped from time to time into the streams, and are now very

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[a] U. S. Biological Survey. Mr. Basil Hicks Dutcher (now Dr. Dutcher, U. S. Army) was in charge of the government party, and is doubtless the man referred to.

numerous. They have never been a popular fish here. When caught they are usually thrown out on the bank and not carried home, and are seldom eaten by any but Japanese and Indians.

The first planting done in the mountains was by a few persons carrying rainbow trout from the Big and Little Kern and their tributaries in cans to the streams and lakes on the western slope of the mountains. Later, clubs were organized and assisted in the work, and in recent years the State fish commissioners have supplied many thousand of small fish for planting in the barren or not well-stocked streams. Among these clubs have been the Visalia Sportsman's Club, the Visalia Game Club, the Eshom Valley Fish and Rifle Club, a club at Porterville, and latterly the Tulare County Fish and Game League, and the Fish and Game Protective Association, of which there are branches at Visalia, Porterville, Threerivers, and near Kings River.

The first planting in the mountains of which we have any record was done by Mark Lavelle and Nick Wren in Mineral King Creek, the trout being brought from the Little Kern in cans on pack animals. Wiley Watson, Arthur Crowley, and W. A. Ward were also among the first to carry rainbow trout from "over the divide" to the Mineral King region. They were planted in Mineral King Creek, Redwood Canyon Creek, and in Eagle, Monarch, Crystal, and Lady Franklin lakes. Captains Parker and Lockett and Lieutenant Dean of the Fourth U. S. Cavalry, and other officers detailed by the acting superintendent of the Sequoia and General Grant national parks, during several years lent valuable assistance in the work of stocking the mountain streams, detailing men and pack trains for the purpose.

No plantings have been more successful than those of grown rainbow trout taken from the Sierra streams. They are prolific and several of the smaller streams have been stocked by rainbows only, placed there a few at a time, and they are good strikers at the fly.

There are still a number of streams entirely barren. Among these are Wolverton Creek in the Sequoia National Park, Whitney Creek (formerly called Crabtree Creek), running from the base of Mount Whitney to Kern River, and Le Conte Creek, having its source near the base of Mount Le Conte and emptying into the Kern. These are all large and ideal trout streams, and should be stocked at once. Other streams barren or imperfectly stocked, are Sherman Creek, East Branch of North Fork of the Kaweah near Redwood Meadow, Horse Creek near Hockett Meadow, Mill Flat Creek, Sampson Creek (a tributary of the last named), Ten Mile Creek, in the same region, and others unnamed. Several lakes northeast of the Mount Whitney trail near Sheep Mountain, three lakes at the head of Sugar Loaf Creek in township 14 south, range 30 east (Mount Diablo base and meridian) and a great number of lakes about the headwaters of many of the smaller branches of the Kaweah and Kings rivers, should be stocked.

In the following tabular statement there are brought together all the records of plantings in this region of which I have been able to secure definite information. For these records I am indebted almost wholly to Mr. Stewart and to Mr. Broder. Doubtless a number of plantings have been made of which we have no complete account, and many persons have been helpful in the work whose names have not been recorded. There are included, on the authority of Mr. H. S. Blood, of Angels, a number of transplantings made in the Sierras west of Lake Tahoe and elsewhere north of the region with which this report more particularly deals.

Table showing transplantings of trout and other fishes in waters of the High Sierras of southern California.

Waters stocked.	Date.	Species.	Waters from which obtained.	Transplanting done by—	Results.
Big Arroyo, tributary to Kern River.	....	(Salmo whitei) ..	Little Kern...........	Edward Hurlburt	
Big Meadow Creek	1897 and since.	Rainbow trout...	....	F. A. Bullard, S. L. N. Ellis, and his sons, Leonard, Marshall, and Marvin.	
Blue Lakes, near head of Mokelumne River.	1864..........	Tahoe trout......	Hope Valley..........	O. S. Boardman, of Gault.	
Blue Lakes............	1873..........	....	North Mokelumne River.	Joseph Emery	
Boulder Creek.........	1897 and since.	Rainbow trout...	....	F. A. Bullard, S. L. N. Ellis, and Leonard, Marshall, and Marvin Ellis.	

Table showing transplantings of trout and other fishes in waters of the High Sierras of southern California—Continued.

Waters stocked.	Date.	Species.	Waters from which obtained.	Transplanting done by.	Results.
Bravo Lake[a]	May 21, 1894	Part of 2,000 fish			
Clover Creek, Sequoia National Park.		Young cut-throat trout.	California fish commission, through Visalia Fish and Game Club	Sequoia Park officials assisted by S. L. N. Ellis.	Successful.
Colony Mill (via Halstead Meadows) and Clover Creek, all streams between	1893	36,000 trout		J. T. Walker, J. O. Thomas, Phil Davis, and Lieut. Rutherford.	Very successful.
Cottonwood Creek	1876	Salmo agua bonita	Mulky Creek	A. C. Stevens, Thos. George and Colonel Stevens.	
Cottonwood Lakes	1891	do	Small tributary of Cottonwood Creek below the falls	E. H. Edwards, M. P. Hand, Manuel Silva, James Moffett and B. H. Dutcher.	
Cross Creek[a]	May 21, 1894	Part of 2,000 fish			
Crystal Lake		Rainbow trout	"Over the divide"	Wiley Watson, Arthur Crowley, and W. A. Ward.	Successful.
Deep Creek[a]	May 21, 1894	Part of 2,000 fish			
Deer Creek above Hot Springs.	Nov. 16, 1904	20,000 eastern brook trout.	Hatchery in Siskiyou County.		
Eagle Lake		Rainbow trout	"Over the divide"	Wiley Watson, Arthur Crowley, and W. A. Ward.	Do.
Elbow Creek[a]	May 21, 1894	Part of 2,000 fish			
Elk Bayou[a]	do	do			
Eshom Creek, below site of Hyde's old mill.	June 1, 1895	18 rainbow trout		M. L. Weaver, W. H. Elam and S. L. N. Ellis.	Do.
Eshom Creek, near Hart's mill	October, 1896	97 rainbow trout	Marble Fork of Kaweah.	R. L. Hill, F. J. Hill, and S. L. N. Ellis.	Failure.
Evelyn or Calhoun Lake.	1901	About 60 trout	Hockett Meadows	Jason Barton and J. W. Fewel.	
Feather River		Tahoe trout	Truckee River	Mr. Pratt, founder of Prattsville, Plumas County.	
Highland Creek	About 1864	do	Hope Valley	H. S. Blood, Mark McCormick and Herman Tyrie.	
Highland Lakes at head of Stanislaus River.	1863	do	Wolf Creek, Carson Valley.	H. S. Blood, of Angels and J. C. Curtis, of Murphys.	
Hockett Meadows, streams in Sequoia National Park.	15 or 20 years ago.	"Rainbow trout" (doubtless Salmo whitei).	Soda Creek		
Horse Creek, north of Hockett Meadows.	1904	About 150 trout	Hockett Meadows	Jason Barton[b] and J. W. Fewel.	
Indian Ditch at Wadsworth, Nev.		Sacramento perch	State Fish Commission	Specimens obtained by Dr. Jordan.	
Independence Lake	Sept. 18, 1893	Part of a consignment of 20,000 trout.		J. S. Johnson and J. T. Walker.	
Kaweah River[a]	May 21, 1894	Part of 2,000 fish, kind not given.			
Above the power house.	Summer, 1902	20,000 young trout		J. T. Walker and Jack Bidwell.	
Near iron bridge, 18 miles east of Visalia.	Oct., 1902	100 black bass	State hatchery	J. T. Walker and a representative of State Fish Commission.	
At points 25 miles from Visalia and above.	1903	20,000 young trout (variety not given).		M. L. Weaver	
At the iron bridge.	July 24, 1904	100 black bass, 3 to 6 inches long.	Sisson hatchery	J. T. Walker and Geo. Reinheimer.	
Marble Fork, of which Clover Creek is a tributary.	1893	1,000 trout		J. T. Walker, J. O. Thomas, Phil Davis and Lieut. Rutherford.	Very successful.
Marble Fork	Sept. 18, 1893	Part of consignment of 20,000 trout.		M. L. Weaver, J. T. Walker, and detachment of soldiers of Fourth U. S. Cavalry.	"Had no fish in 1891. Planted fish in 1893, now plenty."—Stewart.
Do	Aug. 21, 1894	Part of 5,000 cut-throat trout.		M. L. Weaver, F. M. Nobles, and soldiers of the Fourth Cavalry.	

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[a] All these plantings were made in the level San Joaquin Valley at altitudes of 300 to 400 feet.

[b] Mr. Barton states that he has seen no fish below the places where the plantings were made, but that fish are plentiful above. He is of the opinion that trout move up the streams until stopped by barriers, and that they do not move down the streams below the place where they were planted.

Table showing transplantings of trout and other fishes in waters of the High Sierras of southern California—Continued.

Waters stocked.	Date.	Species.	Waters from which obtained.	Transplanting done by—	Results.
Kaweah River, Middle Fork.	1892	Part of 15,000 trout fry.	State hatchery	J. O. Thomas, P. W. Davis, and M. L. Weaver.	
Middle Fork, Shepard's Crossing.	Sept. 3, 1893	15,000 young trout		M. L. Weaver and J. T. Walker.	
Middle Fork	Mar. 2, 1894	Part of 20,000 eastern brook trout.		J. O. Thomas, J. T. Walker, and W. O. Clough.	
Do	1902	Part of 50,000 trout, (species not given).		J. T. Walker and J. O. Thomas.	
Middle Fork, above power house.	Nov. 16, 1904	12,500 eastern brook trout.	State hatchery	J. T. Walker	
North Fork	Aug. 2, 1894	10,000 cut-throat trout.		J. S. Johnson, J. T. Walker, and members of Eshom Valley Fish and Rifle Club.	
North Fork near Old Baldy and Eshom Valley.	1896	Part of 80,000 young cut-throat trout.	Wawona, furnished by the State Fish Commissioners.	Eshom Valley Fish and Rifle Club.	"Not prolific, but grow to a large size."
North Fork near north line of Sequoia National Park.	Sept., 1896	21 golden trout	Volcano (formerly Whitney) Creek.	F. J. Hill, S. L. N. Ellis, and Leonard Ellis.	"Lost track of, but fish resembling hybrids taken several miles below the plant."
North Fork	1897 and since.	Rainbow trout		F. A. Bullard, S. L. N. Ellis, and Leonard, Marshall, and Marvin Ellis.	
Do	1902	Part of 50,000 trout (sp.?)		J. T. Walker and J. O. Thomas.	
Do	Aug. 21, 1904	Part of 5,000 cut-throat trout.		M. L. Weaver, P. M. Norboe, and soldiers of the Fourth Cavalry.	
North Fork. Unnamed tributaries.	1897 and since.	Rainbow trout		F. A. Bullard, S. L. N. Ellis, and Leonard, Marshall, and Marvin Ellis.	
South Fork, at South Fork Meadows.		(Salmo whitei)	Soda Creek at Quinn's Horse Camp.		
South Fork	1892	Part of 15,000 trout fry.	State hatchery	J. O. Thomas, P. W. Davis, and M. L. Weaver.	
Do		Part of 15,000 small fry.	do	P. W. Davis and M. L. Weaver.	
Do	Mar. 2, 1894	Part of 20,000 eastern brook trout.		J. O. Thomas, J. T. Walker, and W. O. Clough.	
South Fork, both above and below falls.	1902	Part of 50,000 trout		J. T. Walker and J. O. Thomas.	
South Fork, small tributary near Sand Meadow.	1903	13 trout	Hockett Meadows	Jason Barton and Chas. Blossom.	Fry seen fall of 1904.
South Fork, near headwaters, about 5 miles above the falls.	1904	125 large trout	do	Jason Barton and J. W. Fewel.	
South Fork	Nov. 16, 1904	12,600 eastern brook trout.	State hatchery	J. T. Walker	
Three lakes in the vicinity of.	"Recently"	Rainbow trout		F. A. Bullard, S. L. N. Ellis, and his sons Leonard, Marshall, and Marvin.	Not yet known.
Lady Franklin Lake		do	"Over the divide"	Wiley Watson, Arthur Crowley, and W. A. Ward.	Successful.
Mineral King Creek	About 1880	Trout (Salmo whitei).	Little Kern	Mark Lavelle and Nick Wren.	
Do		"Rainbow trout"	"Over the divide"	Wiley Watson, Arthur Crowley, and W. A. Ward.	Successful.
Mineral King Creek and other streams in that neighborhood along the road.	Aug. 2, 1894	15,000 cut-throat trout.		M. L. Weaver and Charles G. Wilcox.	
Mokelumne River in headwaters.	1861	Tahoe trout	Hope Valley	Abram Ritchie, of Big Trees, John Christy, of Jenny Lind.	

Table showing transplantings of trout and other fishes in waters of the High Sierras of southern California—Continued.

Waters stocked.	Date.	Species.	Waters from which obtained.	Transplanting done by—	Results.
Monarch Lake		"Rainbow trout"	"Over the divide"	Wiley Watson, Arthur Crowley, and W. A. Ward.	Successful.
Nelson Creek, a small tributary of Tule River.	1897 or 1898	18 trout (Salmo roosevelti).	Volcano Creek	J. M. Nelson	"Successful."?
Nine Mile Creek (also known as Hot Springs Creek).	1897	19 fish, about 10 inches long.	Kern River	John Broder and Don Nelson.	
Nine Mile Creek, an eastern tributary of Kern River below Kern Lake.	1897		do	John Broder	
Oriole Lake, west of Mineral King and the head of a branch of the Middle Fork of the Kaweah.	1880	Black bass		Clay Arnold	No report.
Oriole Lake	1880	Trout		do	Trout have been caught there since.
Poso Creek, Kern County.	1892	Part of 10,000 trout.	State hatchery	J. T. Walker	
Rattlesnake Creek, tributary to Kern River.			Little Kern	John Broder	Not known.
Redwood Canyon Creek.		"Rainbow trout"	"Over the divide"	Wiley Watson, Arthur Crowley, and W. A. Ward.	Successful.
Do	1896	Part of 80,000 young cut-throat trout.	Wawona, furnished by State Fish Commissioners.	Eshom Valley Fish and Rifle Club.	"Not prolific, but grow to a large size."
Roaring River, Tulare County.	1895	Rainbow trout		Andy Ferguson (ex-gamewarden of Fresno Co., Cal.)[a]	Successful.
Sand Meadow, 2 small lakes west of.	1904	About 80 trout	Hockett meadows	Jason Barton and J. W. Fewel.	
Shell Mountain, lake on, altitude 9,000 feet.	May 28, 1895	16 black bass		M. L. Weaver, W. H. Elam, and S. L. N. Ellis.	None seen there since.
Silliman Creek (Sequoia National Park).		Young cut-throat trout.	California Fish Commission, through Visalia Fish and Game Club.	Sequoia Park officials assisted by S. L. N. Ellis.	"Creeks afford good fishing."
Stanislaus River, Middle Fork.		Tahoe trout	Walker River, Nevada.		
Stanislaus River, North Fork, in reservoir of the Union Water Co.	1859	do	Hope Valley, on east slope of Sierras.		
Stony Creek	May 28, 1895	13 rainbow trout		S. L. N. Ellis	Successful.
Sugarloaf Creek, Tulare County.	1895	Rainbow trout		Andy Ferguson	Failure.
Ten Mile Creek	1892	7 small rainbow trout.	Kings River	A. I. Weston	
Ten Mile Creek below Millwood Trail.	1894	23 rainbow trout	do	S. L. N. Ellis	
Truckee River		Sacramento perch.		State fish commission.	
Do		Rainbow trout	State hatchery	do	
Tulare Lake	1880 (about)	Whitefish and catfish.		U. S. Fish Commission.	Whitefish died, catfish thrived well.
Tule River	1892	10,000 trout fry	State hatchery	M. L. Weaver	
At three points (Globe Crossing, Marksburys, McFarlands Bridge).	July 21, 1904	150 black bass 3 to 6 inches long.	Sisson hatchery	F. W. Velie and H. M. Hathaway.	
Middle Fork, above club house.	Nov. 16, 1904	15,000 eastern brook trout.	Hatchery in Siskiyou County.		
South Fork of	do	10,000 eastern brook trout.	do	J. T. Walker	
White River (or small tributary).	1892	Part of 10,000 trout fry.	State hatchery	do	
Whitman Creek:					
Hockett Meadows	1885 or 1890	Rainbow trout (*Salmo whitei*).	Soda Creek		
A branch of Horse Creek.	1904	About 75 trout	Hockett Meadows	Jason Barton and J. W. Fewel.	
Woodard Creek	May 28, 1895	12 rainbow trout		S. L. N. Ellis	Successful.
Do.	October, 1895	21 rainbow trout		E. S. Phillips and S. L. N. Ellis.	Do.

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[a] Mr. Ferguson made more than 150 plantings of trout in the streams and lakes of Fresno County.

TEMPERATURE CONDITIONS IN THE KERN RIVER REGION.

By O. P. JENKINS.

The tributaries of the upper portion of the upper Kern River find their sources amid ridges and peaks of a high altitude which through a great part of the year are covered with snow. The melting of the snow furnishes the streams with their water supply. Even during the summer the supply of snow is not entirely exhausted, and where such is the case the springs whose reservoirs were filled from the melting snow furnish the streams with a constant supply of cold water, the temperature of which the short period of warmth through the middle of the day does not markedly affect. Even in midsummer at these altitudes the nights are cold, the temperature often falling several degrees below the freezing point of water. During the day the sky is more frequently overcast than is the case in most parts of California, and in the highest altitudes light falls of snow are not uncommon. Although these latter usually quickly disappear they add their contribution of cold water to the streams. These conditions insure a comparatively low temperature for the waters of the tributaries of the upper Kern for the whole year.

The tributaries of the Kern, however, all make great and rapid descent to the Kern River. This river also continues to drop rapidly through mountain and foothill regions until it reaches the plains. Through a comparatively short distance waters from melting snows on the summit of Mount Whitney pass by Whitney Creek and the Kern River, in summer from the temperature of melting snow to the plains below where the temperature reaches a point exceeded by few places in the United States. In these lower regions the waters of the river are not reinforced by rains or springs and are unprotected by shade of vegetation. Indeed in this region in summer the waters of the Kern are finally lost by absorption and by evaporation after breaking up into numerous winding streams. In recent times the distribution of these waters is much modified by the great irrigation systems that are developing along the Kern. The natural features thus noted bring about conditions of temperature which make the upper Kern with its tributaries lying in the mountains ideal for trout, while during a great part of the year they render the lower portions of the river lying among the lower foothills and in the plains impossible for this fish.

The land animals and plants along the banks of these streams have been studied by the members of the Biological Survey. The changes in fauna and flora from the summit of Mount Whitney to the plains about Bakersfield include the extremes to be found in the United States. In its descent from Mount Whitney the water passes successively the zones that have been designated Boreal, Transition, Upper Sonoran, and Lower Sonoran by the Biological Survey. No like study of the water forms of animal and plant life of the streams of this region has been made, but from the nature of the conditions no such well-marked zones could be looked for among the aquatic forms as have been found for the terrestrial species. Nevertheless, a careful study throughout could not fail to bring out interesting facts of the distribution of the forms belonging to the streams. As it is, we do not at the present know accurately the lower range of the trout, the farthest upper range of the fishes peculiar to the lower portions of the stream, nor the range of any of the other animals that live with them.

In the following table are given the temperatures of the Kern River in and about Kern Lake, which is but a widened portion of the river caused by a partial choking of the stream in the recent past. The temperatures were taken in the latter part of July. As can be seen, they range from 52.5° to 61° F. Naturally the morning temperatures are lower than those of the later parts of the day, as also are those of the lower depths of the water. The records of the maximum and minimum temperatures at our camp near the shore line of the lake show that the air temperature during the night was even a little lower than the lowest temperature of the water, while during the day it rose far above it, being, indeed, a high summer heat.

TABLE I.—*Water temperatures at Kern Lake.*

Date.	Hour.	Temperature.	Locality.
		° *F.*	
July 19	11 a. m.	56.75	Camp No. 5 (surface of lake).
July 20	8.30 a. m.		Lower end of lake, depth, 12 feet.
		59.75	At surface.
		57.0	At a depth of 2.5 feet.
		56.25	At a depth of 5 feet.
		54.75	At a depth of 10 feet.
Do	10 a. m.		In water just northeast of outlet; depth, 12 feet.
		57.75	At the surface.
		56.0	At a depth of 2.5 feet.
		55.0	At a depth of 5 feet.
		54.75	At a depth of 11 feet.
Do	3.30 p. m.	61.0	Inlet Kern Lake.
July 19	6 p. m.	59.0	Kern River, 1.5 miles below lake.
July 21	4.30 p. m.	60.0	Just above Kern Lake.
Do	9.30 a. m.	54.25	About 1.5 miles above Kern Lake.
July 22	9 a. m.	52.5	Small creek at Camp No. 5, Kern Lake.

The temperature of the air at Kern Lake camp was as follows: July 19, minimum, 50.25°, maximum, 88°; July 20, minimum, 51.75°, maximum, 86.5°; July 21, minimum, 53.5°, maximum, 81.5°.

About 2 miles above Kern Lake, nearly opposite to one another, there empty into the river two tributaries. The smaller one on the west is Coyote Creek, on the east is Volcano Creek. Coyote Creek rises mainly in the Coyote meadow, from which region it passes by a rapid descent to the Kern. In table II the temperatures noted show the low degree of 43.5° taken at the largest spring at its source. From this the temperature rises as the stream descends to about the temperature of the Kern near the mouth of the creek. The constant addition of cold water from small tributaries and springs prevents a greater rise of temperature.

TABLE II.—*Coyote Creek temperatures.*

Date.	Hour.	Temperature.	Locality.
		° *F.*	
July 18	1.30 p. m.	57.0	Coyote Meadow.
Do	do	57.0	Lower end of Coyote Meadow.
Do	2 p. m	62.75	About 1½ miles below Coyote Meadow.
Do	3 p. m	58.0	3 miles below Coyote Meadow.
Do	do	54.0	Lower temperature due to entrance of small tributaries.
July 21	11.45 a. m.	56.0	Just above mouth.
July 30	7 p. m	43.5	At source.

In table III are given the temperatures of Volcano Creek taken from points extending from one-half mile above the mouth of the creek to the portion which lies very near the South Fork of the Kern at the old "tunnel." This latter point is about half the distance from the mouth to the source. No doubt above this point, toward its sources, lower temperatures would have been reached. Although the stream lies in high altitudes, considerable stretches of it wind through meadows where the warmth of the sun has opportunity to raise its temperature. This, however, is compensated by the cold of the nights and the frequent supply of cold water from springs.

TABLE III.—*Volcano Creek temperatures.*

Date.	Hour.	Temperature.	Locality.
		° F.	
July 22	11.50 a. m...	56.25	One-half mile above mouth.
Do.....	4.30 p. m....	55.0	Camp No. 6.
July 23	6.30 a. m....	51.0	Do.
Do.....	7 p. m.......	55.25	Do.
July 24	6.15 a. m....	50.5	Do.
Do.....	12.50 p. m...	54.24	At the tunnel.
July 30	7 a. m.......	51.0	"Grasshopper Meadow."

At our camp near Twin Falls the maximum air temperature, July 23, was 75.3°, the minimum, July 24, 49.5°.

The few observations made on the temperature of the South Fork of the Kern in the region of its approximation to Volcano Creek show its waters to be decidedly warmer than those of Volcano Creek.

TABLE IV.—*South Fork Kern River temperatures.*

Date.	Hour.	Temperature.	Locality.
		° F.	
July 24	1.15 p. m....	60.3	At point where it comes close to Volcano Creek.
Do.....	2.50 p. m....	65.0	At upper end of South Fork Meadows.
Do.....	2.45 p. m....	62.5	Small stream flowing into South Fork of Kern River, at upper end of South Fork Meadows.

Rock Creek is a considerable stream, flowing into the Kern from the east, its middle branch or main stream rising from Sheep Mountain, Cirque Peak, and Mount Le Conte. We have but a single record of temperature from it. This is at a point where the trail crosses it, and is about one-third the length of the stream above its mouth. The temperature here at 3.15 p. m., July 25, was 54°. This observation would indicate that its waters are about the temperature of those of Volcano Creek.

Siberian Outpost is on the upper portion of a branch, the most southern of Rock Creek. It is near the base of Cirque Peak. A short distance from our camp small patches of snow still were to be seen. Temperature of air at 10 p. m., July 24, 52.5°; at 5.45 a. m., July 25, 44.25°.

The records of temperature of Whitney Creek were made at Crabtree Meadow or in its vicinity. This meadow is at a point about one-fourth of the whole length of the stream from its mouth. The record shows the temperature of Whitney Creek to be noticeably lower than that of Volcano Creek. This is due to its higher elevation, its sources in Mount Whitney being longer covered with snow, and the fact that even in summer when they are exposed they more frequently receive supplies from the light snowstorms.

TABLE V.—*Whitney Creek temperatures.*

Date.	Hour.	Temperature.	Locality.
		° *F.*	
July 25	6 p. m	55.0	Crabtree Meadow.
July 26	6 a. m	47.75	Do.
Do.	do	46.0	Near Crabtree Meadow.
Do.	7 p. m	54.0	Crabtree Meadow.
Do.	do	54.0	Near Crabtree Meadow.
Do.	6 a. m	45.0	Crabtree Meadow.
July 27	do	46.0	Do.
Do.	7.45 p. m	54.0	Do.
July 28	6.30 a. m	48.0	Do.
July 29	6 a. m	48.0	Do.
July 25	9 p. m	55.0	Do.
July 26	4.30 a. m	41.0	Do.

On the summit of Mount Whitney during a storm of sleet at 12.30 p. m. July 26 the air was 29°; at 9.30 a. m. July 28, when the sky was clear, it was 39.5°.

The largest tributary of the Kern River is the Little Kern. This stream empties into the Kern far below the region of our investigations. Its headwaters, however, were examined by us and temperatures noted at the points given in table VI. Its sources lie in deep canyons just west of the Great Western Divide and south of Farewell Gap. As seen by the table, these upper sources of the Little Kern in temperature correspond closely with the tributaries of the upper Kern (main stream) east of the Divide.

TABLE VI.—*Little Kern temperatures.*

Date.	Hour.	Temperature.	Locality.
		° *F.*	
July 17	12.30 p. m	57.0	Below Broder's cabin 2.5 miles.
Do.	6 p. m.	51.0	Camp No. 4, Broder's cabin.
Do.	6.30 p. m	55.0	Do.
Do.	7 p. m.	55.0	Do.
July 18	6 a. m.	46.0	Do.
Do.	7.30 a. m	47.0	Do.

At Broder's cabin on Little Kern the air was 51° at 9.15 p. m. July 17 and 53° at 5.30 a. m. July 18. The temperature of the water in Soda Creek, 1 mile below Quinns Horse Camp, at 10 a. m. July 16, was 51°.

In leaving Threerivers for the Mount Whitney region our trail lay along the South Fork of the Kaweah River from near its mouth to its highest sources. This gave opportunity for taking temperatures along almost the whole course of this stream. These records, as given in table VII, show that in the middle of July the temperature ranges from the high point of 70°, near its mouth, to the low temperature of 43°, taken at Camp No. 3, South Meadow, not far from the sources of the river, the temperature falling as the elevation increases. During the latter part of the summer the lower portions of the stream no doubt show a still higher degree.

Table VII.—*South Fork of Kaweah temperatures.*

Date.	Hour.	Temperature.	Locality.
		° *F.*	
July 13	5 p. m.	70.5	Camp 1. Alles' ranch.
Do.	6 p. m.	69.5	Do
July 14	5.45 a. m	62.25	Do.
Do.	6 a. m.	62.0	Do.
Do.	11 a. m.	62.5	5 or 6 miles above Alles' ranch; elevation 2,550.
Do.	12.15 p. m.	63.00	Redwood cabin.
Do.	12.30 p. m.	63.5	About 8 miles above Camp 1.
Do.	3 p. m.	54.5	Small creek some distance above last station.
Do.	7 p. m.	60.5	Camp No. 2, near Sand Meadow.
July 15	6 a. m.	50.25	Do.
Do.	11.50 a. m	56.00	Camp No. 3, on branch South Fork, South Fork Meadows.
Do.	3.45 p. m.	58.0	One-fourth mile below Camp No. 3.
Do.	4.45 p. m.	55.5	Camp No. 3, South Fork Meadows.
July 16	6 a. m.	43.5	Do.
Do.	7.30 a. m	44.0	Do.
Do.	4.45 p. m.	56.0	Do.
July 17	7.30 a. m	45.0	Do.

The only records of the temperature of the air taken along this stream are those of Camp No. 3, South Fork Meadows, near the source of the stream. Abundant frost occurred at night followed by pleasantly warm day temperature, the temperature of the air sinking considerably below that of the water at night and rising far above it in the daytime.

Table VIII.—South Fork of Kaweah air temperatures.

Date.	Hour.	Temperature.	Locality.
		° *F.*	
July 14	10 p. m.	43.5	Camp No 2.
July 15	5 a. m.	31.5	Do.
Do.	9 p. m.	39.0	Camp No. 3.
July 16	Minimum	28.5	Do.
Do.	6.30 a. m	32.5	Do.
Do.	Maximum	71.0	Do.
July 17	Minimum	[a]31.0	Do.
Do.	5.45 p. m	32.5	Do.
Do.	7.30 a. m	49.0	Do.

[a] Heavy frost.

Marble Fork is a branch of the Middle Fork of the Kaweah. It is a stream of considerable size. It flows north of the Giant Forest, then turns to the south and, passing through Deep Canyon, empties into the Middle Fork of the Kaweah. The records of temperature were taken near the bridge on the government road into the forest. This point is about 4 miles from Broder & Hopping's camp. August 3, 7 p. m., 65°; August 4, 8 a. m., 59°.

THE FOOD OF THE TROUT OF THE KERN RIVER REGION.

By Chancey Juday.

The trout investigations that were made in the vicinity of Mount Whitney, California, during July, 1904, included a brief study of the food of some of the trout found in the waters of that region. This study consisted of a careful examination of the stomach contents of 85 trout, these 85 fish belonging to five different species which were obtained from six different streams and one lake. They were caught with hook and line and were taken at different times of the day, chiefly early in the forenoon and toward evening. Thus the contents of these stomachs ought to represent fairly well the natural food of the trout at this season of the year.

About 40 of the stomachs were examined at the time the trout were caught, while the remainder were preserved and their contents have been examined since the time of the expedition. Most of the specimens whose stomachs were examined at the time of their capture were measured and a record of the length was made along with the record of contents of the stomach. In some cases also the sex of the individual was noted. It was not found practicable to keep a record of the length and sex of all the specimens from which stomachs were taken and preserved, but the stomachs of specimens obtained from different localities were kept separate and a record made of the longest and shortest specimens from which they were taken.

The relative quantity of food in each stomach was estimated—that is, whether the amount of food found was a quarter, or a half, etc., of the quantity the stomach would hold with ordinary distension. The relative amount of the various food elements was then estimated and recorded in percentages. The percentage method was used rather than the counting method because the contents of many stomachs consisted largely of fragments so small that it was impossible to place them in the proper group or groups of insects. However, the number of individuals making up the various percentages was also recorded in cases where it could readily be determined. Only a very general classification of the stomach contents was attempted and the following record will show how the various items were noted: Specimen No. 7, length 7 inches; stomach about two-thirds full; contents—1.5 per cent remains of 7 stone-fly nymphs, 95 per cent Chironomidæ (761 chironomid larvæ and 1 pupa), 2 per cent 1 large fly, 0.5 per cent elytron of a small beetle, 1 per cent ants. The insect fragments that were too small to be identified accurately were recorded under the head of "insect fragments" and the Chironomidæ were noted separately from the other Diptera because, in general, they were found to be a more important food element than the other Diptera. The other groups are self-explanatory. The following is a summarized record of the results:

Salmo whitei Evermann.

South Fork of the Kaweah River.—The stomachs of 12 specimens obtained from this stream at South Fork Meadows, on July 15, 1904, were studied. The specimens varied in length from 5.5 to 8 inches. All the stomachs except 1 were estimated to be half full or more.

Arachnida.—Two per cent of the contents of 1 stomach consisted of spiders.

Ephemerida.—Three stomachs contained May-fly nymphs, two 5 per cent, and the other 3 per cent.

Plecoptera.—Forty per cent of the contents of 1 stomach consisted of adult stone-flies, and 2 others contained 5 and 1.75 per cent stone-fly nymphs.

Orthoptera.—The remains of a grasshopper (locust) constituted 25 per cent of the stomach contents of 1 specimen.

Hemiptera.—One specimen had eaten 1 per cent Hemiptera.

Trichoptera.—Four stomachs contained 90, 25, 15, and 5 per cent caddis-fly larvæ, and 3 contained 90, 20, and 1 per cent cases of caddis-fly larvæ.

Diptera.—Three specimens had eaten 10, 6, and 2 per cent Diptera.

Chironomidæ.—Four stomachs contained 95, 80, 3, and 1 per cent chironomid larvæ.

Coleoptera.—The contents of 6 stomachs consisted of 75, 60, 20, 15, 10, and 0.25 per cent beetles.

Hymenoptera.—Three stomachs contained ants, two 25 per cent, and the other 1 per cent.

Insect fragments.—Small fragments of insects constituted from 9 per cent to 85 per cent of the entire stomach contents of 9 specimens.

Vegetable matter.—Five stomachs contained 40, 30, 10, 7, and 0.5 per cent vegetable matter. In one or two instances part of this vegetable matter was probably derived from the cases of caddis-fly larvæ.

The following percentages show the relative importance of the various elements of the stomach contents for all 12 specimens. These average percentages were obtained by adding together all the percentages of each element and dividing this sum by 12. Arachnida 0.16, Ephemerida (May-fly larvæ) 1, Plecoptera (adult stone-flies and nymphs) 3.9, Hemiptera 0.08, trichopter larvæ 11.23, cases of trichopter larvæ 9.2, Diptera 1.5, chironomid larvæ and pupæ 15, Coleoptera 15, Hymenoptera (ants) 4.23, insect fragments 31.4, vegetable matter 7.3. This shows that trichopter larvæ, chironomid larvæ and pupæ, and Coleoptera were the most important food elements, as these three together constituted a little over 41 per cent of the stomach contents of the 12 trout.

SODA CREEK.—Six trout of the same species were obtained from this stream at Quinns Horse Camp on July 16, 1904. They varied in length from 4.5 to 6.5 inches. Five of the stomachs were estimated to be from one-half to two-thirds full and the sixth about one-fourth full.

Ephemerida.—One stomach contained 15 per cent May-fly nymphs.

Plecoptera.—One specimen had eaten 15 per cent adult stone-flies and two had each eaten 20 per cent stone-fly nymphs.

Orthoptera.—One specimen contained 25 per cent remains of a grasshopper (locust).

Trichoptera.—Three stomachs contained 60, 20, and 15 per cent caddis-fly larvæ and another 90 per cent larvæ and larval cases together.

Chironomidæ.—The contents of one stomach consisted of 1 per cent chironomid larvæ.

Coleoptera.—Twenty per cent of the contents of one stomach and 5 per cent of another consisted of remains of beetles.

Hymenoptera.—One stomach contained 15 and another 10 per cent ants.

Insect fragments.—The contents of all six stomachs consisted of 10 per cent to 99 per cent small fragments of insects.

Vegetable matter.—Two specimens had partaken of vegetable matter to the extent of 5 and 2 per cent.

The following are the average percentages for these six specimens: Ephemerida (May-fly nymphs) 2.5, Plecoptera (adult stone-flies and nymphs) 9.22, Orthoptera 4.16, trichopter larvæ 30.82, chironomid larvæ 0.16, Coleoptera 4.16, Hymenoptera (ants) 4.16, insect fragments 43.66, vegetable matter 1.16. Trichopter larvæ, with an average of 30.82 per cent, formed the most important element of the food of these specimens, and adult stone-flies and nymphs were second in importance.

LITTLE KERN RIVER.—The 41 trout (*Salmo whitei*) obtained from this stream were caught in the vicinity of a place called Broder's cabin on July 17, 1904. They varied in length from 5 to 8 inches. The stomachs of 34 were estimated to be half full or more; the others were less than half full.

Trout egg.—A trout egg constituted 5 per cent of the contents of one stomach.

Hydrachnida.—Five stomachs contained hydrachnids; one contained 1 per cent and the other four each 0.25 per cent.

Ephemerida.—May-fly nymphs constituted from 1 to 5 per cent of the contents of eight stomachs.

Plecoptera.—Adult stone-flies constituted 15 per cent of the contents of two stomachs, stone-fly nymphs 10 and 5 per cent of two others, and pupæ 1 per cent of another.

Orthoptera.—Two stomachs contained 50 and 2 per cent remains of grasshoppers (locusts), and fragments which appeared to be parts of a mantis composed 2 per cent of the contents of another.

Hemiptera.—Thirteen stomachs contained from 1 per cent to 10 per cent *Hemiptera.*

Trichoptera.—Six specimens had eaten 0.5 per cent to 30 per cent caddis-fly larvæ and six others contained 1 to 8 per cent cases of caddis-fly larvæ.

Lepidoptera.—Moths constituted 15 per cent of the contents of two stomachs, 3 and 2 per cent of two others, while 15 per cent of the contents of another consisted of a caterpillar.

Diptera.—One stomach contained 15 per cent Diptera, one 5 per cent, three 2 per cent, five 1 per cent, and two 0.5 per cent.

Chironomidæ.—Chironomid larvæ and pupæ were found in 24 stomachs and constituted from 0.25 to 10 per cent of the contents.

Coleoptera.—Beetles were found in 38 stomachs. They made up from 10 to 50 per cent of the contents of 26 stomachs and 1 to 9 per cent of the contents of the other 12.

Hymenoptera.—Forty of these 41 trout had eaten insects belonging to this order. Thirty-nine had eaten from 2 to 35 per cent ants; six had eaten 2 to 10 per cent bees; and nine, 1 to 8 per cent other *Hymenoptera.*

Insect fragments.—Small fragments of insects constituted from 10 to 92 per cent of the contents of 40 stomachs.

Vegetable matter.—Sixteen stomachs were found to contain from 1 to 10 per cent vegetable matter.

Sand.—The contents of 8 stomachs consisted of 1 to 8 per cent sand. It appeared that a large part of this sand had been derived from the larval and pupal cases of insects.

The following are the average percentages for these 41 specimens: Ephemerida (May-fly nymphs) 0.7, Plecoptera (adult stone-flies and nymphs) 1.28, Orthoptera 1.4, Hemiptera 0.95, trichopter larvæ 1.4, cases of trichopter larvæ 0.7, Lepidoptera (moths) 1.3, Diptera 0.88, chironomid larvæ and pupæ 1.41, Coleoptera 15, Hymenoptera 15, insect fragments 57.11, vegetable matter 1.4, sand 1.3. The above percentages show that Coleoptera and Hymenoptera were the two chief constituents of the stomach contents of these specimens. The 15 per cent of the latter was made up of 12.8 per cent ants and 2.2 per cent other Hymenoptera. Parasitic thread-worms (Nematoda) were found in 68 per cent of these trout. Some stomachs contained as many as 10 of these parasites.

COYOTE CREEK.—Only one trout from Coyote Creek was studied. The specimen was a male, 6 inches long, and its stomach was estimated to be one-third full. The stomach contents consisted of the following: Plecoptera (stone-fly nymphs) 15 per cent, Neuroptera (a dobson) 25 per cent, chironomid larvæ 2 per cent, and insect fragments 58 per cent.

Salmo gilberti Jordan.

UPPER KERN LAKE.—Six trout were obtained from Upper Kern Lake on July 19 and 21, varying in length from 7 to 19.75 inches. The stomach of the longest specimen was empty and only two of the others were estimated to be as much as half full.

Ephemerida.—May-fly nymphs constituted 5 per cent of the contents of one stomach.

Chironomidæ.—One stomach contained 25 per cent chironomid larvæ.

Hymenoptera.—The contents of one stomach consisted of 3 per cent ants and 2 per cent other Hymenoptera.

Insect fragments.—Most of the insect fragments were too small for identification. These small fragments constituted 94 per cent of the contents of one stomach, 93 per cent of another, 50 per cent of another, and 10 per cent of each of two others.

Vegetable matter.—Ninety per cent of the contents of one stomach consisted of pieces of a *Batrachium* which was growing abundantly in the lake; another contained 90 per cent *Batrachium* and algæ; another 25 per cent vegetable matter, and a fourth 2 per cent *Batrachium.*

Sand.—Sand constituted 1 per cent of the contents of one stomach.

The average percentages for these Upper Kern Lake specimens are as follows: Ephemerida (May-fly nymphs) 1, chironomid larvæ 5, Hymenoptera 1, insect fragments 51.4, vegetable matter 41.4, sand 0.2. The chief characteristic of these averages is the high percentage of vegetable matter.

KERN RIVER.—One specimen, a female 11 inches long, was caught about a mile above Upper Kern Lake on July 21. Its stomach contained Plecoptera (stone-fly nymphs) 15 per cent, Neuroptera (a dobson) 30 per cent, Coleoptera (beetle remains) 2 per cent, and insect fragments 36 per cent.

Salmo roosevelti Evermann.

VOLCANO CREEK.—Eighteen golden trout were obtained from Volcano Creek on July 22 and 23, 1904, all caught in the lower course of the creek only two or three miles above its mouth. The longest and shortest trout measured, respectively, 11 and 5 inches. The stomachs of 7 of them were estimated to be half full or more, while the others were only a quarter to a third full.

Arachnida.—Spiders constituted 5 per cent of the contents of 1 stomach.

Ephemerida.—Two to 10 per cent of the contents of 7 stomachs consisted of adult May flies and 12 stomachs contained from 1 to 30 per cent May-fly nymphs.

Plecoptera.—Three stomachs contained 10, 5, and 2 per cent adult stone flies and 12 from 3 to 25 per cent stone-fly nymphs.

Orthoptera. The stomach contents of 4 trout consisted of 50, 6, 5, and 2 per cent pieces of grasshoppers (locusts).

Hemiptera.—Five stomachs contained 0.25 to 2 per cent Hemiptera.

Trichoptera.—The contents of 5 stomachs consisted of 40, 18, 10, 5, and 2 per cent adult caddis flies; 12 contained from 0.25 to 15 per cent caddis-fly larvæ, and 14 contained larval cases varying in amount from 1 to 25 per cent.

Lepidoptera.—Eight per cent of the contents of 1 stomach consisted of remains of moths.

Chironomidæ.—Eight specimens had eaten from 0.5 to 8 per cent chironomid larvæ.

Coleoptera.—Beetles constituted 1 to 3 per cent of the stomach contents of 7 specimens, and larvæ of diving beetles (water tigers) constituted from 3 to 8 per cent of the contents of 7 specimens, 5 of which contained no other Coleoptera.

Hymenoptera.—Ants constituted from 1 to 20 per cent of the stomach contents of 13 specimens.

Insect fragments.—From 1 to 88 per cent of the contents of all the stomachs consisted of small fragments of insects.

Vegetable matter.—Two stomachs contained 8 per cent vegetable matter, one 5 per cent, two 1 per cent, and one 0.5 per cent.

Sand.—The stomach contents of 9 individuals consisted of 1 to 60 per cent sand, which was derived chiefly from the cases of insect larvæ and pupæ.

The average percentages for these 18 golden trout are as follows: Arachnida 0.29, Ephemerida (May-fly nymphs) 7, Plecoptera (adult stone flies and nymphs) 12.2, Orthoptera 3.5, Hemiptera 0.27, adult and larval Trichoptera 7.22, cases of larval Trichoptera 7, Lepidoptera (moths) 0.45, Diptera 0.9, chironomid larvæ 1.5, Coleoptera 2.67, Hymenoptera (ants) 4.1, insect fragments 41.9, vegetable matter 1.3, sand 9.7. These percentages show that the most important elements of the food of the golden trout at the time these specimens were caught were May-fly nymphs, adult stone flies and nymphs, and adult caddis-flies and larvæ. Ants ranked next in importance. Only two of these stomachs contained threadworms (Nematoda).

DISCUSSION OF RESULTS.

If the foregoing results may be taken as representative of the various streams from which these specimens were obtained, the trout in them were dependent almost wholly on insect life for their food at the time these investigations were made. In fact, judging from the scarcity of other animal forms that might serve as food, adult insects and the aquatic larvæ of insects must play a very important rôle in the food supply of these trout during the entire year. It is possible, of course, that the small trout may be eaten by the larger ones at times, but no such cannibalistic tendencies were found among the specimens examined, the only indication of cannibalism noted being the single trout egg eaten by one specimen.

The relative importance of the different groups of insects was very different in the different localities. The specimens from the South Fork of the Kaweah River had fed most abundantly on trichopter larvæ, chironomid larvæ and pupæ, and Coleoptera; trichopter larvæ ranked highest with the trout from Soda Creek, with adult stone-flies and nymphs second in importance; those from the Little Kern River had partaken most freely of Coleoptera (beetles) and Hymenoptera (ants); and the golden trout had fed most freely on May-fly nymphs, adult stone-flies and nymphs, and adult and larval Trichoptera. These investigations were not sufficient to determine whether these differences in diet were due to a choice of food by the trout or whether they were the result of differences in the distribution of the different kinds of insects resulting from local conditions. The latter was probably a very important factor in producing these differences, as it was noted that the aquatic larvæ varied, not only in actual numbers but also in relative abundance, in the different localities.

Vegetable matter formed a comparatively small part of the stomach contents of the specimens obtained from streams, and probably much of this was taken by accident. Three of the trout from Upper Kern Lake, however, contained considerable quantities of vegetable matter, so that part of it, at least, must have been taken purposely.

In the cases where the sex was noted there was no apparent difference in the diet of the male and female.

CLADOCERA AND COPEPODA OF THE KERN RIVER REGION.

Cladocera.—The Cladocera collected in upper Kern Lake on July 20 represented only two forms, *Eurycercus lamellatus* O. F. Müller and *Chydorus sphæricus* O. F. Müller, which, however, were abundant.

The material collected from Hockett Lakes on July 16 contained the following Cladocera, which, with the exception of *Daphnia* and *Polyphemus*, were abundant:

Diaphanosoma leuchtenbergianum Fischer. This form apparently belongs to Lilljeborg's variety *megalops*. The head is narrow and its ventral margin is concave in some specimens, just as shown in figure 7, plate IV, Cladocera Sueciæ. The eye is large, about five-sixths of the width of the anterior part of the head.

Daphnia longispina O. F. Müller.
Scapholeberis mucronata O. F. Müller.
Simocephalus serrulatus O. F. Müller.
Ceriodaphnia pulchella Sars.
Streblocerus serricaudatus Fischer.
Eurycercus lamellatus O. F. Müller.
Lynceus affinis Leydig.
Chydorus sphæricus O. F. Müller.
Polyphemus pediculus Linnæus.

Copepoda.—Dr. C. Dwight Marsh has identified the following copepods collected in Kern Lake and Hockett Lakes:

From Kern Lake, *Cyclops serrulatus* Fischer and *Cyclops albidus* Jurine.

From Hockett Lakes, *Cyclops serrulatus montanus* Brady, *Cyclops albidus* Jurine, and *Diaptomus signicauda* Lilljeborg.

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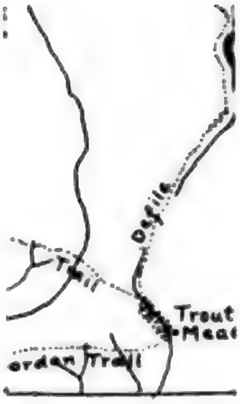
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CONTRIBUTIONS FROM THE BIOLOGICAL LABORATORY OF THE BUREAU OF FISHERIES AT WOODS HOLE, MASS.

THE PHYSIOLOGICAL EFFECTS UPON FISHES OF CHANGES IN THE DENSITY AND SALINITY OF WATER

By FRANCIS B. SUMNER, Ph. D.
Director Fisheries Laboratory, Woods Hole, Mass.

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INTRODUCTION.

It is a commonplace to both fisherman and zoologist that certain fishes dwell exclusively in salt water and others exclusively in fresh water, while others yet may live indifferently in either medium. It is well known, also, that death is frequently the result of an abrupt and considerable change of density.

Numerous problems of great physiological importance are here involved. Why is an extreme change of density so fatal in some cases and so harmless in others? And is it the change of density which is responsible for the harmful effects, after all? May not salt water be toxic, in a narrower sense, to fresh-water fishes, and vice versa? In any case, what is the immediate cause of death? Are the limiting membranes of a fish permeable to both water and salts, or are they only semipermeable? Or, are they, perhaps, impermeable to both? And are all of the limiting membranes alike in this regard? Likewise, is their condition the same for all species and under all circumstances? These are closely related questions. They have received many and quite contradictory answers. It is hoped that the experiments discussed in the ensuing pages have contributed something toward their solution.

The first of these experiments were chiefly concerned in determining whether a given change in water density was harmful to a given species of fish, records being kept of the rate of death. In a second series weight determinations were made with a view to ascertaining whether such changes in the density of the surrounding medium were accompanied by appreciable osmotic effects upon the fishes. Third, it was sought to discover whether the membranes were permeable to water only or to salts as well. The passage of salts from the fish into the surrounding water was tested chemically, and likewise the salt content of the tissues of fishes of several species under different conditions was determined. Finally, a series of experiments was performed with a view to discovering whether such osmotic exchanges were confined to the gills or whether the general body integument was likewise concerned.

The experiments here described were carried on during the summers of 1904 and 1905 at the biological laboratory of the Bureau of Fisheries at Woods Hole, Mass., and during the spring of 1905 at the New York Aquarium. In the earlier portion of this work I was aided by Mr. D. W. Davis, assistant in this laboratory. The work at the New York Aquarium was rendered possible through the kindness of the director, Mr. C. H. Townsend, who placed at my disposal a room equipped for research, and provided me with abundant material throughout the course of the experiments. I must acknowledge, also, the ever-ready help of several members of his staff. My thanks are likewise due to Prof. W. C. Sabine, of the department of physics of Harvard University, for valuable criticism.

THE DEATH OR SURVIVAL OF VARIOUS SPECIES AFTER CHANGES IN THE SALINITY OF THE WATER.

THE FATAL EFFECT OF FRESH WATER UPON VARIOUS SALT-WATER FISHES.

My experiments were originally undertaken from a biometric rather than a physiological point of view. It was my object to determine measurable indices of fitness and unfitness among the individuals of a species, somewhat as Bumpus had done for sparrows and Weldon for crabs. Different modes of elimination were chosen, chiefly asphyxiation and change from salt to fresh water. The individuals of the more and the less resistant halves of each lot of fish so treated were subjected to statistical study and differences in type and in variability were noted. These biometric studies are still far from complete and no statement of the results is here attempted. My attention has for a time been diverted to the physiological questions which form the basis of the present paper.

The first experiments recorded illustrate the fatal effects of transfer to fresh water upon our three local species of killifish (*Fundulus*). These are all small fishes, restricted to shallower waters. *F. majalis* and *F. heteroclitus* are marine littoral forms, occurring particularly on weedy shores, though both species, and especially the latter, pass into the brackish waters. Bean (1903) says of *heteroclitus* that it sometimes ascends streams beyond tidewater, and regarding *majalis* he sees "no reason to doubt its occurrence, even in fresh water," while Eugene Smith (1897) states of *heteroclitus* that it "is often found landlocked in ice or quarry ponds." Dr. H. M. Smith informs me that the latter species "is found permanently in the vicinity of Washington, in the Potomac and its tributaries, and also in ponds." Mr. Vinal Edwards likewise reports a case where this fish was found in fresh water above a milldam. Fresh water is not, however, the more usual habitat of *F. heteroclitus*. *F. diaphanus*, on the contrary, is predominantly a brackish and fresh water fish, extending from the coast far into the interior, and occurring in lakes and streams as far west as the Mississippi River, and northward to Minnesota.[a] These three species are readily distinguishable from one another in form and color. They are very different in their habits and in various physiological characters. Accordingly, the species should always be specified in any work dealing with a member of this genus.[b]

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[a] The western representatives of the species have been given the rank of a distinct variety, *menona*.

[b] For descriptions and illustrations of these fishes the reader is referred to Jordan and Evermann's "Fishes of North and Middle America," and to Garman's "The Cyprinodonts" (1895).

The first three experiments deal with *F. majalis*.

Experiment 1.[a]

August, 1902. Three hundred and forty-four fishes put into tank of salt water and latter displaced by fresh. Fifty per cent of the fish died during first 24 hours; only 1 fish living at end of 3 days.

Experiment 2.

August, 1904. Twenty-five picked specimens placed abruptly in tank of fresh water. All but 1 dead in 18 hours; all dead within 24 hours.

Experiment 3.

September, 1904. Twenty-five picked specimens placed abruptly in fresh water. Fish fed throughout experiment. Thirty-six per cent dead at end of first day; last fish dead in 6 days.

The fishes here used had been taken in sea water of full strength, and kept, prior to the experiments, in tanks of running salt water of a mean density of about 1.023 (reduced to 4° C.) and a mean temperature ranging from 20° to 22° C. The change of temperature in the transfer from salt to fresh water was very slight (probably never exceeding 3° C.) and can have played no part, here or in later experiments, in causing the death of the fishes.

The next two experiments illustrate the relative mortality of *F. majalis* and *F. heteroclitus*, and, in the second case, of *F. diaphanus*.

Experiment 4.

July, 1904. Thirty-three *F. majalis* and 71 *F. heteroclitus* put into tank of salt water, this being displaced by running fresh water as in experiment 1.

F. majalis. No deaths during first day; 42 per cent dead within 2 days; 88 per cent dead within 3 days; the last in 4½ days.

F. heteroclitus. First death in 3½ days; 75 per cent dead within 6½ days; all dead within 7½ days.

Experiment 5.

July, 1904. Twenty-eight *majalis*, 32 *heteroclitus*, and 22 *diaphanus* were put directly into a tank of running fresh water, at 20° C. The *majalis* and *heteroclitus* came directly from sea water of full strength, the *diaphanus* from a tank of brackish water of specific gravity 1.006[b] (originally from a brackish pond having water of specific gravity 1.005).

F. majalis died in from less than 12 to 36 hours; *F. heteroclitus* died in from 12 hours to 10 days; *F. diaphanus* died in from 5 to 14 days. All of *majalis* had died at a time when only 7 *heteroclitus* (22 per cent) and when no *diaphanus* had died; and all of *heteroclitus* had died at a time when only 59 per cent of the *diaphanus* had died.

The order of death of these three species when subjected to asphyxiation in stale water was found to be (1) *diaphanus*, (2) *majalis*, (3) *heteroclitus*.

Experiment 6.

Eighty-seven per cent of the *diaphanus* had died when only 35 per cent of the *majalis* had died and when all of the *heteroclitus* were still living.

Experiment 7.

Results similar to experiment 6.

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[a] These experiments are not numbered in chronological order, but are throughout arranged solely with reference to subject-matter. The first twelve are among those conducted at Woods Hole.

[b] See p. 60.

Throughout all of these experiments, healthy fishes were selected unless otherwise specified. Fishes having the same history as those used for experiment were commonly kept in the reserve tanks and served for purposes of control. Special control experiments were likewise carried on from time to time, as will appear.

In a number of other experiments the harmful effects of transfer to fresh water upon *F. heteroclitus* were manifest.

Experiment 8.

August, 1904. Of 26 fishes, none died until the lapse of 6 days, when they began to succumb. Fifty-eight per cent had died in 10 days, when the experiment was discontinued.

Experiment 9.

August and September, 1904. The fishes began to die in 3 days, and 50 per cent died during the first 10 days. From the thirteenth to the nineteenth day, however, no deaths occurred and the experiment was discontinued.

Experiment 10.

September, 1904. Of 202 fishes used, 3 died during the first day, while 95 per cent died within 10 days.

Garrey (1905), speaking of some experiments of his own upon this species of fish, states: "It was found that if care was taken to select individuals which were not injured in catching, about 80 per cent lived in fresh water for 6 weeks, when the experiment was discontinued. This is as high a percentage as can be kept alive in the sea-water aquaria of the laboratory." Garrey's statement is surprising in view of my own results already cited, and of the confirmatory experiments recorded below. It is to be remarked that many of my experiments were carried on at about the same time as those of Garrey, and that the fresh water employed came from the same water system as that used at the Marine Biological Laboratory, where Garrey's work was done. The fishes that I used were generally treated with the utmost care and in many specified cases were fed throughout the experiment. Fishes from various localities were used. The conditions were likewise varied from time to time so that irrelevant factors might be eliminated.

Experiment 11.

July, 1905. Thirty specimens of *F. heteroclitus* put into a hatching box filled with running fresh water. Another 30 specimens taken from the same lot of fish were placed in an adjacent hatching box filled with running salt water. Both sets of fishes were fed, although those in the fresh water showed little desire for food. The temperature of the salt water was about 3° C. higher than that of the fresh.

In the fresh-water tank 1 fish died within 2 days, and the last died within 14 days. In the salt-water tank not a single fish died during this period.

Experiment 12.

Summer of 1905. The first fish died after 7 days in fresh water, and a single fish remained living at the end of 20 days.

It is to be added that I have given the results for all of the experiments of this nature performed by me, no contradictory figures being suppressed, here or elsewhere.

That the fresh water here used was not contaminated with any actively poisonous substance is shown by the fact that the addition of even a very small proportion of salt water entirely prevented the harmful effects. No trace of fungus was to be observed and no surface lesions of any sort were discoverable. Lack of some or all of the saline ingredients of sea water seems to have been responsible for the death of the fishes. Perhaps the most curious feature in these results is the prolonged period of resistance shown by some of the fishes in each experiment. This suggests certain of the results of Bert (see p. 67).

Some observations made in New York City during the past winter and spring are interesting by way of comparison with the preceding results. In these later experiments the fishes came from marshes of brackish water, and were kept for some days or weeks prior to the experiments in water of a salinity slightly over half that of water from the open sea. The temperature at the time ranged from 2° to 16° C., that at Woods Hole having ranged from 20° to 22° C. These experiments were complicated by the appearance of fungus (*Saprolegnia*), which invariably devastated the tanks within a week or two after *F. heteroclitus* was placed in fresh water. Even here, however, it was noted that a certain proportion of those which died showed no traces of *Saprolegnia*.

Experiment 13.

New York, November and December, 1904. Two hundred and eleven *F. heteroclitus* transferred to fresh water. Thirteen died within the first 15 days before the disease appeared; 82 per cent of the remainder died during the next 16 days, after which the experiment was discontinued.

A certain proportion of these fishes died without being affected by the fungus, but it is of course impossible to determine what the death rate would have been if the *Saprolegnia* had not appeared. It must be remembered that fishes which are already weakened by other causes are more ready victims to the fungus. It was found in experiment 41, *c*, and others that the addition of even a small percentage of sea water served as a decided check to the appearance of the parasite. It is my belief that this preventive action of the sea salt was due not so much to a toxic effect upon the fungus as to a beneficial physiological effect upon the fishes, resulting in a greater power to resist the parasite.

Experiment 14.

It was here observed that the fungus, when once it had gained a foothold upon the fishes, continued to thrive after the latter were transferred to water of density 1.005, while few traces appeared upon fishes which were transferred in a healthy condition to water of this density.

In some cases (experiment 41, *c*) water of a much lower degree of salinity acted as an effective check.

It is evident from experiment 13 (which was repeated with similar results) that, under the conditions existing at the time, fresh water proved much less rapidly fatal to *Fundulus heteroclitus* than in the Woods Hole experiments, and this in spite of the fungus. The factor responsible for this difference may have been either (1) the lower temperature, or (2) the previous history of the fish (life in diluted sea water), or perhaps the two combined. It nevertheless seems quite probable, although no definite control experiments were made, that even here the fresh water had a deleterious effect.

It will be recalled that in experiment 5 the *F. diaphanus* finally succumbed to the effects of the fresh water, though outliving, on the average, both of the other species. The death of this species in fresh water was very surprising, since the specimens here used came from a brackish water pond (Tashmoo Pond, Marthas Vineyard) having a specific gravity of only 1.005 (corrected), and had been kept in the laboratory prior to the experiment in water of about the same specific gravity. It is to be remembered, too, that this species occurs in nature in fresh-water lakes and streams. The above results, however, were sustained by further experiment.

Experiment 15.

> Woods Hole, September, 1904. Twenty-five healthy specimens of *F. diaphanus*, from a lot which had been kept in the laboratory (water 1.004 to 1.006) for 11 days, put directly into running fresh water. Fishes fed throughout. Two fishes died within 24 hours; 16 (64 per cent) died within 8 days, when the experiment was discontinued. Meanwhile, in a control tank of brackish water containing large numbers of this species, very few died.

Cyprinodon variegatus, a brackish and salt-water fish belonging to the same family as *Fundulus*, was chosen as a subject for similar experiment.

Experiment 16.

> Woods Hole, August, 1904. Two well-fed specimens of *C. variegatus* from salt water placed directly in fresh water. Both were dead on the following morning.

The "white perch" (*Morone americana*), as is well known, may occur either in fresh, salt, or brackish water. It is not certain, however, that in nature the change is abruptly made.

Experiment 17.

> Woods Hole, September, 1904. Of 10 specimens of *Morone* from brackish water (1.004 to 1.006), which were transferred to fresh, 4 had died and 1 sickened within 8 days, when the experiment was discontinued. Experiment 36 (p. 67) serves as a good control.

Experiments with *F. diaphanus* and the white perch during the summer of 1905 show that the capacity of different individuals to endure transfer either to fresh or to salt water varies greatly, depending upon the condition of the fishes. It seems likely that a white perch from brackish water may in some cases survive indefinitely after transfer to fresh water, though this is certainly not true of all specimens. Those which survive the initial period of mortality seem qualified to resist the harmful effects.

Of the typically marine fishes few were tested as to their ability to withstand abrupt transfer to fresh water, since this is well known to result fatally in the case of most species. Scup (*Stenotomus chrysops*) were found to die in from 1 to 3 hours, the fishes being taken from water of a specific gravity 1.023 and temperature about 20° C. Two puffers (*Spheroides maculatus*) died within 3 hours under the same conditions. Some cunners (*Tautogolabrus adspersus*) were dead at end of 12 hours (perhaps much less), and of 2 tautog (*Tautoga onitis*) 1 died within 12 and a second within 24 hours. Sculpin (*Myoxocephalus octodecimspinosus*), sea raven (*Hemitripterus americanus*), and sea bass (*Centropristes striatus*) all died within a day (probably much less).[a] The winter flounder (*Pseudopleuronectes americanus*) survived considerably longer, as appears from experiment 48, while the tomcod (*Microgadus tomcod*), or at least some individuals, continued to live indefinitely after the change. It is to be remembered, however, that the tomcod is an anadromous fish.

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[a] Experiments with these and the next two species mentioned were performed at the New York Aquarium, where the salt water had a much lower density. (See p. 68.)

EFFECT OF DISTILLED WATER.

Loeb (1900, p. 334) has stated that "*Fundulus* can be thrown from sea water into distilled water without any considerable swelling, or without any visible injurious effects." It is possible that Loeb would not regard death as a "visible injurious effect." In four experiments with *F. heteroclitus* (the species studied by Loeb) I found that death resulted after an interval of from less than a day to 3 days. Ten fishes at a time were put into several liters of distilled water. The latter was aerated in all cases but one, though this precaution was quite needless, since even a greater number of fishes may be kept in an equal quantity of sea water which is neither changed nor aerated. The fishes in my experiments came not from full-strength sea water but from the supply system of the New York Aquarium (at this time density = 1.015). Whether or not "swelling" was evident before death I did not determine, but the dead fishes were found in one case to have gained more than 10 per cent in weight.

SYMPTOMS PRECEDING THE DEATH OF SALT-WATER FISHES IN FRESH WATER.

Fundulus heteroclitus, as stated above, took little or no food when in fresh water, sometimes tasting and then rejecting it, while those in the control tank crowded eagerly to get it. They were ordinarily far more sluggish in their movements than the normal fishes, but at times, especially when disturbed, they were subject to peculiar paroxysms. A fish so affected would start suddenly upon an erratic course around the tank, swimming in a zigzag or circular path and ending in a state of tetanus, the body rigid and twitching slightly. For a period the fish would remain nearly or quite motionless, commonly somewhat flexed, the mouth open and the gill covers widely extended. After a few minutes respiration was resumed and the fish gradually assumed a normal aspect. Sometimes my approach to the tank was sufficient to provoke these paroxysms in one or more fishes.

These same phenomena I have likewise observed very plainly in *F. diaphanus*, and in one instance in *F. majalis*. Most marine fishes, however, die much more rapidly than either of these, and quite different symptoms are manifested. Scup (*Stenotomus chrysops*), when placed in fresh water, settle at once to the bottom, and sooner or later "keel over," though this is generally deferred for some time. Respiration is at first nearly or quite normal, both as to rate[a] and manner. Later it becomes irregular, the normal rhythm being interrupted at intervals by spasmodic gulps accompanied by general agitation. The fish from time to time darts violently about the tank, as if in an effort to escape, sometimes even leaping from the water. These frantic movements of the body recur at intervals, even after respiration has ceased. The rate of respiration does not decline gradually, but the rhythmic movements give place rather abruptly to convulsive ones, which soon cease altogether. As already stated, death occurs in from 1 to 3 hours after transfer to fresh water.

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[a] Six specimens were observed, their rate of respiration being determined by means of a stop watch. These individuals differed considerably in their reactions.

Puffers (*Spheroides maculatus*) upon the approach of death were found to inflate and deflate their bodies and to gnash their teeth quite audibly. The other symptoms were much the same as those described for the scup.

These phenomena (in those fishes which die speedily) undoubtedly suggest death from asphyxiation, and indeed this explanation has been offered to account for the fatal effects of fresh water upon salt-water fishes and vice versa (see p. 101.). A careful comparison of the preceding phenomena with those manifested by scup which were allowed to die from asphyxiation (the water supply to the tank being stopped) undoubtedly showed points of resemblance. There were in both cases disturbances of respiration, frantic endeavors to escape, and convulsive movements ending in death. In both cases, fishes were observed to eject water from the mouth while at the surface. There were, however, some characteristic differences in the symptoms, indicating differences in the physiological effects.

Bert (1871) states of the goldfish that when placed in salt water its respiration is at first accelerated and then retarded. No such rule was found to obtain in the case of the scup when allowed to die in fresh water, and indeed no constant change of rate occurred until shortly before respiration ceased.

EFFECT OF SURFACE ABRASIONS.

Bert (1883) notes that the removal of the mucus from a portion of the skin of an eel (fresh-water specimen) renders it vulnerable to the effects of salt water, which may otherwise work no harm.

Garrey (1905), like Bert, holds that the integrity of the skin is an important factor in determining whether or not certain changes of medium shall prove fatal. Furthermore, he argues that at least one salt-water fish (*F. heteroclitus*) will die in its normal medium if the skin be injured extensively:

> A large number of healthy specimens were selected and about one-half the body surface denuded of scales by gentle scraping with the edge of a scalpel, or the skin was removed over an area of one square centimeter on each side; then they were divided into three lots and placed respectively into fresh, sea water diluted with an equal volume of distilled water, and normal sea water. Of those kept in fresh water in every experiment from eighty to ninety per cent died within twenty-four hours, while all died in less than thirty-six hours. In normal sea water the fish suffered a similar fate, although death did not intervene so soon. But of those kept in sea water of one-half its normal concentration only three per cent were dead at a time when all those in the other two media had died, and seventy per cent were kept alive for four weeks, when the wounds were all healed and the experiments discontinued. In these experiments, therefore, no deleterious effects obtain when the internal and external media are approximately isotonic.

In the case of the hypertonic or hypotonic solutions, however, Garrey believed that the damaged integument rendered possible a fatal osmotic action.

A priori it does not seem probable that every considerable surface abrasion should prove fatal either to a marine or a fresh-water fish in its normal medium. Indeed, we have abundant proof that the more hardy species can survive serious mutilations. Experiments of my own, moreover, suggested by those of Garrey, give results entirely contradictory to his.

In experiment 5, five of the 28 specimens of *F. majalis* were deprived of their scales throughout an area of about 1 square centimeter on the shoulder region. Of the 18 fish (64 per cent) which died during the first 12 hours, none were found to be the scraped ones.

Again, in experiment 45 (p. 74), specimens of *F. heteroclitus*, taken from salt water of density 1.007+[a], were thoroughly denuded of their scales throughout a strip about 1 centimeter in width and extending from the head to the dorsal fin. The fish were divided into lots of 16 each and put into water of five different densities.

In the fresh-water lot 2 died within the first 2 days and 6 within the first 7 days, when the experiment was given up owing to fungus, which appeared early and thus complicated the result. (Compare with experiment 41, *b*, in which normal fishes were used.) All of Garrey's fresh-water lot died within less than 36 hours.

The next lot were placed in water having a density of about 1.001 (sea water = 1.020 to 1.028). Only one fish (apparently one otherwise injured) died during 5 days, after which the experiment had to be given up owing to fungus.

The third lot, placed in the salt water of the aquarium supply (1.007), were all well at the end of 5 days, when the experiment was discontinued.

The fourth lot were put into a stronger salt water brought from Sandy Hook (density 1.014, i. e., about one-half the salinity of normal sea water). They were kept in a tub without aeration. One fish died in 5 days.

The fifth lot were placed in water of a density 1.025 (Sandy Hook water, strengthened by the addition of a commercial sea salt, thus raising the density somewhat above that of the sea water at Woods Hole). Three died within the first 4 days, after which 6 days more elapsed without a single death. It was found that the injured surfaces had healed and that the scales had begun to regenerate. All of Garrey's salt-water lot died, though he does not tell us how soon.

The changes in weight undergone by these scraped fishes are very instructive and will be dealt with later.

The temperature of the fresh water at this time was 8° to 9° C., that of the salt water being 4° to 6°. The fishes had not been fed for more than 16 days prior to the experiment.

During the summer of 1905 a few similar experiments were performed. The conditions were, however, necessarily different. The salinity of the water from which the fishes came was here more than three times that of the water at the New York Aquarium, while the temperature was of course very much higher.

Experiment 18.

Woods Hole, August, 1905. Thirty *F. heteroclitus* denuded of scales over one entire side of the body. Divided into lots of 10 each which were put into salt water, fresh water, and water of density 1.001, respectively. During the period covered by the experiment (14 days) the results were as follows: (*a*) In salt water, 3 dead, 7 alive and apparently well; (*b*) in fresh water, all dead in from 2 to 13 days; (*c*) in 1.001 water, none dead. In the last case (*c*) the water contained 1 part of fresh to about 25 parts of sea water.

Experiment 19.

Woods Hole, summer of 1905. Seven fishes in fresh water all died within 24 hours.

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[a] This being the density of New York Bay water at this time of the year. See p. 68.

Experiment 20.

This lot of fishes, in salt water, likewise showed a higher mortality than those in experiment 18, though here other causes probably complicated the results.

ACCLIMATIZATION.

Since certain of the fishes used in the above experiments are, in nature, often found in fresh water, it was thought that they might be accustomed to it in the laboratory by a comparatively rapid process of acclimatization.

Experiment 21.

Woods Hole, August and September, 1904. Twenty-five selected specimens of *F. heteroclitus* transferred from salt to fresh water through hourly steps of about 0.001 in specific gravity.[a] First 2 fishes died 6 days after reaching fresh water; 40 per cent (10 fishes) died within first 11 days; only 2 more died within the following 19 days, when the experiment was discontinued.

It is evident that the harmful effects of the change to fresh water have not been prevented, though comparison with preceding experiments suggests that they have here been diminished.

Experiment 22.

Woods Hole, August and September, 1904. Twenty-six *F. heteroclitus* transferred from salt to fresh water through steps of 0.001 per day.[b] First fish died 6 days after reaching fresh water; 1 more dead and another sick on the following day, when the experiment had to be discontinued.

It is to be noted that no deaths occurred during the 20 days occupied by the transfer and that all of the fish were healthy at the time of entering fresh water. Taken by itself this experiment would not seem convincing, but in connection with others it is significant.

If complete acclimatization to fresh water within a short period failed in the case of *F. heteroclitus*, it is not surprising that this proved true of *F. majalis* as well.

Experiment 23.

Woods Hole, August, 1904. Twenty-four large selected *F. majalis* transferred to fresh water through a series of hourly steps of 0.001 in specific gravity. (See footnote under experiment 22.) First 2 fishes died within 2 days after reaching fresh water; 50 per cent died within 3 days; last one died in 8 days.

Comparison with experiments 1 to 5 shows that the period of resistance was somewhat prolonged by even this brief period of acclimatization. The same phenomenon is even better illustrated by the next experiment.

Experiment 24.

Woods Hole, August and September, 1904. Same as last, except that daily steps of 0.001 (approximately) were substituted for hourly ones. Fishes fed throughout. First 2 died 4 days after reaching fresh water; last fish lived 9 days (then disappeared).

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[a] These fishes remained through one night, however, about midway in the scale.

[b] The actual reading of the salinometer at 20° C. was here used, no correction being made for temperature. Hence the last step was much greater than the preceding ones, being in reality from specific gravity 1.003 to 1, instead of from 1.001.

Eugene Smith (1902) says of this species that it "can be accustomed to the [fresh water] aquarium by gradual steps," but he does not state how gradual these steps must be.

Experiment 25.

Woods Hole, August and September, 1904. Three *Cyprinodon variegatus* treated as in preceding case. Two died 3 days and one 4 days after reaching fresh water. (Compare experiment 16.)

Experiment 26.

Woods Hole, August and September, 1904. Thirteen cunners (*Tautogolabrus adspersus*) treated as were the fishes in the two preceding experiments. All died within 12 hours after reaching fresh water though apparently healthy till this occurred.

Experiment 27.

Woods Hole, August and September, 1904. Nine black-fish (*Tautoga onitis*) treated as were fishes in experiments 24, 25, and 26, except that an additional step was interposed just before the change to fresh water, which was thus reached somewhat less abruptly. Nearly all of these fish died within 12 hours and all died within 24 hours after reaching fresh water. Up to this time they appeared to be in perfect health.

The foregoing experiments prove, if anything, that fresh water itself is fatal to the fishes under consideration, and that the degree of abruptness with which the change is made is of secondary importance. There is evidence, nevertheless (experiments 21 to 25), that a certain modification may result whereby the fatal effect of the final change is deferred. A partial acclimatization of a somewhat different character is reported by Bert (1871), who succeeded in accustoming various fresh-water fishes to water of half the density of that of the sea, though abrupt change to this proved fatal. De Varigny (1892), likewise accustomed young eels to water containing five-tenths per cent sodium chloride, though the additions of salt had to be very gradual.

ENDURANCE IN WATER OF LOW SALINITY.

It is plain from certain of the preceding experiments that some fishes which die quickly in pure fresh water will endure, for short periods at least, water of a very low degree of salinity. Special experiments were made with a view to testing this point.

Experiment 28.

Woods Hole, September, 1904. Seventy-five specimens of *F. heteroclitus*, from same lot of fishes as those used in experiment 10, were changed from salt water (density 1.023)[a] abruptly to water of density 1.004. No deaths in 11 days, after which experiment was discontinued. Compare with experiment 10, for which this serves as a good control.

Experiment 29.

Woods Hole, September, 1904. Twenty-five *F. majalis* subjected to same treatment and with same results.

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[a] Unless otherwise specified the density here given has been corrected for temperature—i. e., the specific gravity at 4° C. is given.

Experiment 30.

Woods Hole, September, 1904. Agrees with the preceding except that the water density was 1.003. The results were the same.

Experiment 31.

Water of density 1.002 was employed, and only 1 fish died, on the 10th day, after which the experiment was discontinued.

During the season of 1905 some individuals of this species were found to survive 15 days (i. e., until the experiment was discontinued) in water having only about 3 per cent of the salinity of the local sea water (experiment 31 bis). In this case, however, a large majority of the fishes had died in the meantime, and it would therefore seem that the physiological limit of dilution had been passed. In a few cases the same symptoms were observed as in the case of *F. heteroclitus* in pure fresh water. (See p. 61.)

The same result is less strikingly shown in the case of sculpins (experiment 46). Two of these fishes put into fresh water died within 24 hours (perhaps much less), while of 3 from the same lot which were put into water having a specific gravity of about 1.001[a] 1 survived 6 days, when death occurred, the remaining 2 for 3 days, when they were put back (living) into salt water.

The water used in the last two experiments had only 3 to 4 per cent of the salinity of pure sea water. If the mere change in the osmotic pressure of the surrounding medium were responsible for the harmful effects, it would not be expected that transfer to water of a very low degree of salinity would result in little or no harm to the fish, when transfer to pure fresh water was so quickly fatal. This salutary influence of a very small proportion of salt in the water is later shown to be related to an important difference in its effect upon the salt content of the body (pp. 90 et seq). The latter is shown to undergo a serious diminution in fresh water, while little or no diminution occurs if the water be even slightly saline.

EFFECT OF TRANSFER OF BRACKISH AND FRESH WATER FISHES TO SALT WATER.

Experiments 32–35.

Woods Hole, July, August, September, 1904. *Fundulus diaphanus* from a brackish pond (density 1.005 to 1.006) transferred directly to sea water. The record of deaths in the four cases reads:

Experiments.	1 day.	2 days.	5 days.	13 days.
32 (30 fish)	1	1	2	13
33 (25 fish)	12(?)	[a] 20	....	....
34 (50 fish)	30	34	38	(?)
35 (25 fish)	0	1	5	....

[a] Discontinued.

These differences in the death rate are doubtless due to the condition of the fishes at the time of experiment. Those used in experiment 33, for example, had remained unfed for about 3 weeks. During the summer of 1905 the experiments were repeated with similar results, confirming (1) the harmful effects of this abrupt change of water density, and (2) the variability of different lots of fishes in their capacity to endure the change (in some lots a large majority survived). These experiments show furthermore that those fishes which survive the first few days after the transfer to salt water may continue to live in the latter for an indefinite period (one set observed as much as 23 days). It is curious to relate that the survivors in experiment 32 (9 fishes at the end of 19 days), upon being transferred abruptly to fresh water, continued alive for the next 10 days, after which their history was not noted.

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[a] On some occasions the salinity fell to about one-half of this.

Several experiments with the white perch (*Morone americana*) indicate that an abrupt change from slightly brackish water to full-strength sea water is generally fatal, under laboratory conditions at least. Here again a great deal depends upon the condition of the fishes. During the present season, in several lots transferred to salt water, the majority of individuals were dead within 24 hours. One experiment during the preceding summer, however, gave different results.

Experiment 36.

Ten fishes transferred to salt water survived 8 days, after which they were not observed.

It must be noted, however, that the brackish water was more saline in the latter experiment, and consequently the change in density was not so great.

Young of the chinook salmon (*Oncorhynchus tschawytscha*), weighing from 8 to 30 grams, which had been reared in fresh water, were placed abruptly in water of density 1.013[a] without harm, but this is not surprising in view of the life history of this species.

A few species of exclusively fresh-water fishes were likewise experimented upon, but it was not thought necessary to do so with many, since the commonly fatal effects of salt water upon these fishes are already well known. Three yellow perch (*Perca flavescens*) and three sunfish (*Eupomotis gibbosus*) were dead after 14 hours (probably much less) in the diluted salt-water supply of the New York Aquarium (density 1.015 at the time). One catfish (*Ameiurus nebulosus*) was found dead after 18 hours in water of density 1.014. Several of this species in another experiment were nearly dead after two days, but in this latter case the density of the water was 1.010. Hence the harmful effects were naturally diminished. Four rudd (*Leuciscus erythrophthalmus*), put directly into water of density 1.010, died some time between 24 and 48 hours after the change. In another case (experiment 50) 8 of these fishes died within 24 hours in water of density 1.011.

Bert (1871, 1873, 1883) has discussed at considerable length the fatal effects of transferring fresh-water fishes to salt water. He gives a list of species experimented upon, with the average time which elapsed before death in each case, ranging from eighteen minutes for the "ablette" (a cyprinoid) to a period of from one day to a month or more in the case of the eel. Bert points out the effect of higher or lower temperature in hastening or retarding the death of fishes under these conditions. He likewise describes the symptoms attending the death of a goldfish when it was thrown into sea water: violent agitation, followed by quiescence; rise of the fish to the surface, due to lower specific gravity; disturbances of respiration (at first accelerated, then retarded); changes in the color of the gills; opacity of the crystalline lens; increased secretion of mucus; loss of weight. The muscles responded to stimuli, and the heart continued beating after all external signs of life had disappeared. Bert found that his fishes would endure abrupt transfer to mixtures of fresh and salt water, provided that not more than one part of sea water to two parts of distilled water were used. He states that the fatal effects commence at the point where the water is capable of exercising an exosmotic action on the fish, though he gives no evidence for this view. By a gradual process of acclimatization, however, he accustomed fresh-water fishes to live in water having one-half the salinity of that of the sea. The specific gravity of such individuals was thereby raised, for, if returned to fresh water, they were found to sink to the bottom.

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[a] This was the density of the salt-water supply of the New York Aquarium at the time. It is likely that they would have withstood the transfer to full-strength sea water equally well.

Conversely, Bert states that in the case of certain unspecified sea animals "acclimatization takes place easily up to a diminution of about a third in the salinity of the sea water, and that beyond that death comes very readily." That this latter conclusion is unjustified in the case of the great majority of marine fishes is shown in the next section.

Bert's explanation of the "mechanism of death," in the case of fresh-water fishes transferred to salt water, will be discussed later.

CHANGES IN WATER DENSITY AT THE NEW YORK AQUARIUM.[a]

The present salt-water supply of this aquarium is derived from New York Bay, which, as is well known, receives the waters of the Hudson River and a number of lesser streams, and contains in consequence a much-diluted sea water. Its specific gravity rarely attains and perhaps never exceeds 1.016, while during the spring months it falls at times to 1.006, and occasionally lower. Considering the density of water in the open sea as 1.027 (the mean for the North Atlantic), the water supply of the New York Aquarium never reaches two-thirds, and occasionally falls to one-fifth of this. Nevertheless, marine fishes of 173 species[b], belonging to 72 different families, have been kept in this water, some of them surviving for a considerable number of years. Except in the case of fishes from the immediate vicinity, where the water is also of low density, the new arrivals undergo an abrupt change from full-strength sea water to this much-diluted water of the aquarium. This is true, for instance, of more than 50 species of fishes from Bermuda, many of which have been kept very successfully under these unnatural conditions, some individuals having survived as much as 7 years. It must be added, however, that these semitropical fishes are received only during the summer months and that the water containing them is warmed during the winter.

EFFECT OF ALTERNATION OF FRESH AND SALT WATER.

Experiment 37.

Woods Hole, August and September, 1904. Twenty-five *F. heteroclitus*, from sea water, put into fresh and salt water alternately, one change being made daily. During the 13 days of alternating density only 1 fish died. Compare with experiment 9, in which more than half of the fish (taken from the same stock but kept in fresh water) had died in this period.

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[a] These facts are furnished through the courtesy of the director, Mr. C. H. Townsend.

[b] Based upon an incomplete list.

Experiment 38.

Woods Hole, September, 1904. Twenty-five *F. majalis* changed daily from salt to fresh water, and vice versa. No harmful results during the 8 days through which the experiment continued. (Compare with experiments 1 to 5.)

Experiments 39 and 40.

Woods Hole, August and September, 1904. *F. diaphanus* was used. In each case the effect of this treatment was the death of a larger or smaller proportion of the fishes, though perhaps the daily handling had something to do with the result.

In experiments 37 and 38 it was seen that no harm resulted from the alternation of fresh and salt water within the period of observation. Previous experiments had shown, however, that fishes of the same species when left uninterruptedly in fresh water sooner or later succumb. Giard (1900) narrates the case of a stickleback which lived in this way for many weeks. Rutter (1904) states that young Pacific salmon when transferred from fresh water to diluted sea water fared better "when the density alternated from low to high and back again." There is an obvious parallel between such fluctuations of salinity and those which result from the ebb and flow of the tide at a river's mouth.

AGE IN RELATION TO ENDURANCE OF CHANGE OF MEDIUM.

According to Rutter (1904), the young of the quinnat salmon could endure progressively higher degrees of salinity as they grew older, ranging from 25 per cent sea water at 6 days to practically pure sea water at 2 months.

Loeb (1894) records a similar correlation between the age of the embryo of *Fundulus* (*heteroclitus*) and the proportion of NaCl which could be added to the sea water without arresting development.

Brown (1903) states that "there is a gradual increase in susceptibility to osmotic changes and to the electric current as the embryo develops." He regards the latter susceptibility as a function of the former.

A considerable series of measurements of *F. majalis* failed to reveal any selective mortality in relation to size among fishes dying from the effects of fresh water. Such a selective mortality was very obvious, on the other hand, in the case of death from asphyxiation, the "eliminated" set having an average length about 7 per cent greater than the "surviving" set (i. e., those last to die).[a]

ADAPTATION TO CHANGES IN THE MEDIUM IN NATURE.

That many species in nature may be found in either medium is well known. All of the anadromous fishes of course belong to this class, together with the eel (catadromous). Many other salt-water fishes venture into streams and may even become landlocked. Again, fresh-water fishes may be carried down to the sea by freshets and survive in waters of considerable salinity. In most cases it is impossible to determine how abruptly the changes are made. The ascent of a large river may occupy weeks, and during the earlier stages of the journey a zone of gradually decreasing (generally of fluctuating) density is passed through. I am informed by

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[a] I hope before long to present these results in a form which will meet the demands of the biometrical critic.

Dr. Evermann, however, that in the case of the Pacific salmon the passage into the fresh water may be made quite abruptly at the mouths of the smaller streams.

Mather (1881) publishes a list, based mainly upon the authority of J. W. Milner and G. B. Goode, of "fishes which can live in both fresh and salt water." This list aggregates 33 species, and it would probably be possible to enlarge it very greatly.[a] Nothing is said, however, regarding the duration or circumstances of the change of medium, and physiologically these are of course highly important. By sufficiently slow acclimatization almost any change of habitat seems possible, and indeed such a process must have occurred on an enormous scale in the evolution of fishes.

CHANGES OF WEIGHT RESULTING FROM CHANGES IN WATER DENSITY.

CHANGES OF WEIGHT IN LIVING FISHES.

Thus far the discussion has been confined mainly to the death or survival of the various fishes under the conditions of experimentation, but little analysis being attempted of the phenomena involved. It is evident that such changes of density as we have dealt with involve enormous changes in the osmotic pressure of the medium with which the fish is bathed. In relation to the latter, the limiting membranes of a given fish might be (1) impermeable both to water and to salts therein dissolved; (2) semipermeable, permitting the passage of water, but barring the salts; (3) permeable to both in greater or lesser degree. If the first condition were realized, no change in weight ought to occur following the transfer of the fish from one medium to another; if the second condition obtained, we should expect an increase of weight in hypotonic solutions and a decrease in hypertonic ones; while in the third case we should expect the same results in a somewhat lesser degree, unless, indeed, the membranes were equally or almost equally permeable to water and salts, in which case the conditions necessary for osmotic action would be wanting.

It must be remembered, however, that we are dealing with living matter, bounded by living membranes, and that the conditions may in consequence be much more complicated than outlined in the foregoing scheme. Various so-called "vital" (i. e., as yet unexplained) factors may intervene. Thus the degree of "permeability" of a given membrane may not be a constant quantity; it may be found to be in some way under the regulative control of the organism, and to vary greatly at different moments and under different conditions. Again, it may be that chemical factors intervene, and that an imbibition of water may at times occur which is not accounted for by the laws of osmotic pressure alone; and indeed we have already noted a vast difference between the physiological effects of fresh water and of slightly saline water, a phenomenon not to be accounted for by their difference of osmotic pressure.

If the weight of a given fish remained constant in a given medium[b], it might, then, be concluded either (1) that the medium was nearly or quite isotonic with the body fluids of the fish, or, if not, (2) that the membranes of the fish were for the time being impermeable to water, or (3) that they were more or less permeable to both salts and water, but to one in nearly the same degree as to the other.

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[a] Dr. Gill has informed me of several examples not included in Mather's list.

[b] Always allowing for loss due to waste.

If the fish lost in weight, it would be necessary to conclude that the medium was hypertonic.[a] But the limiting membranes, in order to produce this effect, might be either semipermeable (entirely preventing the passage of salts), or permeable to both water and salts, though to the latter in a lesser degree than to the former.

If a gain of weight occurred, it might be concluded either (1) that the medium was hypotonic, in which case the membranes might belong to either of the categories mentioned in the preceding paragraph; or (2) that an imbibition of water had taken place, due to a chemical union of some sort. It will be shown that in the case of dead fishes such an imbibition takes place regardless of the osmotic pressure of the medium.

It must be repeated that the behavior of the membranes of a given fish varies greatly with the conditions, and that seemingly contradictory results may be obtained with fishes of the same species. An extensive series of experiments which was carried on during the spring of 1905 at the New York Aquarium gave results that were almost wholly in harmony with one another, and certain conclusions were framed which seemed to be supported by nearly all of the facts then known to me. A repetition of some of these experiments during the summer of 1905 gave, in certain cases, quite different results, and led to a modification of some of my conclusions. The only differences in the conditions, so far as I am aware, were the temperature of the water and the previous history of the fishes used. The New York experiments, since they form a harmonious series, will be described first, after which the Woods Hole experiments will be discussed and an attempt made to harmonize some apparent contradictions.

The method employed throughout this portion of the work was to weigh the fishes carefully before and after the change in the density of the medium. This procedure involves numerous difficulties. In the first place, fishes under such treatment should not be fed, since the gain or loss of weight through feeding or defecation would confuse the results. Fortunately, most fishes may be kept unfed for days or weeks without any appreciable detriment to their health. In the second place, it is necessary to determine the normal loss of weight through waste which would occur throughout the period of the experiment. This rate of decrease for the fishes used was in many cases determined before the commencement of the experiment; in other cases a control set was kept under observation. In the third place, and this is all-important, the same conditions must be maintained each time the fishes are weighed. The difference in the amount of moisture adhering to the body surface may make a serious difference in the weight recorded, even 1 or more per cent in the case of smaller fishes.[b]

In most of my experiments the aggregate weight of a number of fishes subjected to the same treatment was taken. They were commonly laid upon a dry towel for one-half minute, then laid upon a soft cloth for one-half minute more, the cloth meanwhile being moved in such a way that the fishes should be gently rolled over the surface. Where the procedure was varied, care was taken that the same conditions should obtain throughout the entire experiment. To meet the criticism that the removal of mucus from the surface introduced an abnormal condition into the experiment, fishes were in some cases weighed after being simply drained for a period upon a towel. Of course the weight determinations in these cases were not so accurate.

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[a] The question of gain or loss of weight through the taking in or passing out of matter from the alimentary canal is here left out of account. It will be dealt with later.

[b] It was at first thought necessary in each case to dip the fishes into water of the same density before weighing, in order that the water adhering should be of the same specific gravity, but this was found not to be worth while.

Experiment 41.

New York, April, 1905. *F. heteroclitus*, from salt water of the New York Aquarium (density 1.008, temperature 5° C., at commencement of experiment), unfed for 4 days, divided into lots of 25 each, and treated as follows:

(*a*) Kept in salt water (1.008 to 1.010, during period of experiment).

	Grams.
April 8	249.5
9	247.6
10	247.0
11	245.8
12	245.0
13	244.0
15	243.5

Loss of weight 1 per cent during first 2 days, 2.4 per cent during first 7 days.

This lot of fish serves as a good control for the others of the series.

(*b*) Put into running fresh water (temperature 8° C.).

	Grams.
April 9, 3 p. m.	194.2
9, 3.05 p. m.	194.9
9, 4.05 p. m.	196.7
10	198.5 (all well)
11	197.3 (all well)
12	195.6 (a few beginning to sicken)
13	194.6 (fungus appearing)

During the next 4 days a number of fishes were removed, some of these having fallen prey to fungus. April 17, 5.30 p. m., the remaining 14 fishes weighed 109.6 grams. They were then transferred to salt water of density 1.018. At 6.20 p. m. they weighed 108.6 grams; April 18 (p. m.), 100.6 grams.

Results: An appreciable gain in 5 minutes after transfer to fresh water; a gain of 1.3 per cent in 1 hour; a gain of 2.2 per cent in 1 day, followed by loss, as in *a* above; after change to salt water, a loss of 8.2 per cent in 1 day.

It is to be noted that the loss of weight after the second change was much greater than the gain after the first.

(*b′*) Boiled (fresh) water used, instead of running water, resulting in a gain of 5 per cent in 1 day, 14 per cent in 2 days.

In this experiment 4 fishes were sick on the second day, while all but 4 were dead on the third. Here and elsewhere the death of the fish was accompanied by much more rapid imbibition of water.

(*c*) Fishes put into water averaging about 1.001 (ranging from a half point below to a half point above this figure).

	Grams.
April 8	248.6
9	250.9
10	246.9
11	245.5
12	244.7
13	243.2
15	242.9
17, 5.15 p. m.	241.5

Fishes then put into 1.025 water.

	Grams.
April 17, 6.15 p. m.	239.6
18, p. m.	228.5
19	225.6

Fish in good condition up to this time.

Results: In water of density 1.001, a gain of nearly 1 per cent in first day; a loss of 2.2 per cent in 2 days, of 3.7 per cent in 8 days. After change to salt water, a loss of 6.6 per cent in 2 days.

(*d*) Water of density 1.015 (sea water from Sandy Hook, slightly diluted). Loss of 1.3 per cent in 2 days, of 3.1 per cent in 11 days. The fishes remained in perfect health throughout. It is not at all probable that the decrease during the first 2 days is significant.

(*e*) Water of density 1.025 (Sandy Hook water, strengthened by addition of commercial sea salt). This particular lot of water had, for some reason, a harmful effect upon the fishes, 16 of them being removed dead or in a dying condition during the first 9 days. The results are none the less worth recording: Loss of 1.3 per cent during first hour; of 4.1 per cent during first day; of 8.3 per cent during first 2 days. After this the decrease was far less rapid.

At the end of 9 days the 9 remaining fishes were put into the salt water of the aquarium supply (now 1.010). The weight remained practically stationary (loss of less than 1 per cent) during the next 3 days.

Comparison of *c* with *b* figures is interesting, the gain following transfer to this slightly saline water being much less than that in fresh water. It is also to be recorded that no deaths occurred in the 9 days during which the fish were in the slightly saline water, while 11 fishes were in this time removed, either dead or sick, from the fresh water. The absence of fungus from these fishes seems to be due not so much to the fatal effect of the salts upon the fungus (for the latter will thrive in water of much greater salinity, see p. 59) as to a salutary effect upon the fishes themselves. It is well known that fishes which are in good health are most resistant to fungus, while those which are in poor condition most readily succumb to it.

The loss of weight in *F. heteroclitus* when changed from diluted sea water (1.013) to nearly full strength sea water (1.023) is shown once more in the case of the fishes used in experiment 86; but in this case no harmful effects resulted to the fishes, and the experiment is therefore of greater significance. The loss of weight here was 2 per cent during the first day.

In another experiment (experiment 81) in which fishes from (diluted) salt water (1.013) were transferred to fresh, there was a gain of 2 per cent during the first day, followed by a loss of more than 1 per cent during the second.

Experiment 42.

New York, April, 1905. Nine *F. heteroclitus* which had been for six days in fresh water were put back into the salt water of the aquarium (1.009). A loss of nearly 3 per cent occurred during the first day, after which the weight remained stationary for a day.[a] It would thus appear that water of this density was hypertonic to fishes which had lived in fresh.

Experiment 43.

In this experiment *F. heteroclitus* was transferred to fresh water. The fishes were throughout weighed individually. The results are in agreement with the foregoing, but the figures are not given, since the method of procedure was not so careful, this being the first of my experiments in weighing.

It seems to me that all of the results thus far tabulated are in harmony with the following provisional hypothesis: The body fluids of the fishes used had, at the commencement of the experiments, an osmotic pressure lying somewhere between that of water of density 1.005 and water of density 1.015. Transfer to a medium which was decidedly hypertonic resulted in loss of weight; transfer to a medium which was decidedly hypotonic resulted in a gain in weight. In the former case, the osmotic pressure of the fluids of the fishes was raised, in the latter case it was lowered. In neither case, however, was an osmotic equilibrium between the "internal and external medium" established. The osmotic pressure of the body fluids of the fishes fluctuated within a much narrower range than did that of the surrounding water. Furthermore, the change in weight bore no constant ratio to the change in the osmotic pressure of the water, as a comparison between the *b* and the *c* figures shows. Again, it is evident here and elsewhere that greater changes in weight occurred in those cases in which the fishes were affected harmfully by the new medium.

It is only fair, however, that I should mention one experiment with *F. heteroclitus*, in which the results are hard to reconcile with the others.

Experiment 44.

New York, April, 1905. Twenty-five fishes changed from water of density 1.010 to water of density 1.018. Not only was there no loss, but apparently a slight gain during the first day, followed by a decrease of about 1½ per cent on the second. The accidental dropping of a bit of food into the tank might have been responsible for the result, though this can not be assumed as an explanation.

The experiment in which the scales were removed prior to the change of medium has already been discussed (pp. 62–64) in reference to the survival of the fishes. An analysis of the changes in weight is here worth while.

Experiment 45.

New York, April, 1905. For an account of conditions see page 63.

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[a] It must be recorded here that the 9 fishes were all that survived of a lot of 50, the remainder of which had died from fungus. These survivors showed no traces of fungus, however, and seemed to be in perfect health.

(*a*) Fishes in (dilute) salt water (1.007 to 1.009). Loss of 1 per cent in 5 days. In experiment 41, *a*, where normal fishes were used, there was a loss of 1 per cent in 2 days, but the fishes had been much more recently fed than in the present experiment (here unfed 16 days), which may account for the difference.

(*b*) In fresh water (running). Gain of 2.8 per cent in 2 days, 4 per cent in 4 days, after which the increase ceased. Here the gain for the first 2 days is only slightly in excess of the gain in 1 day in the case of the normal fish (experiment 41, *b*).

(*c*) In 1.001 water (running). Gain of 1.4 per cent in 2 days. (Unfortunately the gain in 1 day was not determined). In experiment 41, *c*, the fishes gained 1 per cent during the first day, then lost.

(*d*) In 1.014 water. Loss of 1.2 per cent in 2 days. This loss is not more than is accounted for by waste.

(*e*) In 1.025 water. Loss of 4.3 per cent in 1 day; 6.1 per cent in 2 days. In experiment 41, *e*, these losses were 4.1 and 8.3 per cent, respectively, but this is hardly a fair comparison, since in the latter case the water was for some reason harmful to the fishes.

It will thus be seen, by comparing the experiments upon sound fishes with those in which the fishes were scraped, that the removal of scales throughout a large area did not result in increasing the influx or efflux of water resulting from changes in the density of the medium. Garrey's contention (p. 62) thus appears to be disproved. Indeed, later experiments seem to indicate that it is through the membranes of the gills and not through the general body integument that these osmotic changes mainly occur.

The following experiment shows strikingly the difference between the effect of pure fresh water and water which is slightly saline. It also illustrates the alternate gain and loss of weight which a fish may undergo in consequence of repeated changes of density.

Experiment 46.

New York, April, 1905. Five specimens of the 18-spined sculpin (*Myoxocephalus octodecimspinosus*) taken from salt water of density 1.009.

(*a*) Two specimens put directly into fresh water. After 24 hours both were dead. Average increase in weight, 4.3 per cent.

(*b*) Three put into 1.001 tank (density ranging from a half point above to a half point below that figure). Average increase of 2.4 per cent during first day; 8.8 per cent during 3 days.

At this time two of the fishes (Nos. 1 and 3) were sick, the other (No. 2) appearing quite well. It is to be noted that the gain in weight was considerably less in the case of this latter fish. The two former fishes were accordingly put back into the salt-water tank (now of density 1.011), No. 2 being left in the 1.001 tank. No. 2 gained an additional 2 per cent during the following day and died after 2 days more (6 days after beginning of experiment). Nos. 1 and 3 underwent loss of 6.5 per cent during next 4 days (in salt water).

These last were then put for a second time into 1.001 tank, when there resulted a gain of 4.8 per cent in 1 day.

The experiment was discontinued after 4 days of 1.001 water. At this time 1 fish was dead, the other feeble.

Experiments 47 and 48.

New York, April, 1905. Six tomcod (*Microgadus tomcod*) and 10 winter flounders (*Pseudopleuronectes americanus*) were used, respectively. With each species a comparison was made between the effects of fresh water and of the slightly saline water. With the former species the gain was slight (about 1 per cent in each case, though here slightly less in the fresh water), and even the transfer to fresh water seemed to have little or no harmful effect. Most of the fishes lived until killed by fungus, from 1 to 4 weeks later.

In the case of the flounders there was a gain of about 5 per cent in 1 day in each sort of water. In fresh water, however, the fishes died in 2 days, in the slightly saline water in from 4 to 5 days.

Weight determinations were likewise made in the case of certain fresh-water fishes transferred to salt water.

Experiment 49.

New York, April, 1905. Three catfishes (*Ameiurus nebulosus*) put into salt water (1.010+). Average decrease for all, 8.3 per cent in 17 hours; average decrease for two, 15.8 per cent in 48 hours.

One of the fishes, being put back into the 1.001 tank at the end of 17 hours, regained in 2 days nearly all that it had lost. Those in salt water were very feeble at the end of the second day.

Experiment 50.

New York, April, 1905. Eight rudd (*Leuciscus erythrophthalmus*) had lost over 4 per cent at end of first day in water of density 1.011. All dead.

It seemed particularly worth while to test the changes of weight in the case of certain fishes which may survive abrupt change from fresh to salt water, and which in nature inhabit both. Hence the next six experiments.

Experiment 51.

New York, May, 1905. Five white perch (*Morone americana*), taken from a fresh-water pond, lost on the average 4.7 per cent during the first day after the change to salt water (1.012). During the preceding 2 days the loss from waste had been only 2.2 per cent or slightly over 1 per cent per day. The fish all appeared perfectly well after the change.

Experiment 52.

Five other specimens of the white perch (taken from salt water) were transferred to fresh. The average weight of these remained almost exactly stationary during the following day, after which they were not weighed. It must be remembered, however, that stationary weight implies a gain sufficient to cover the loss through waste. Nevertheless, such a result was not what I had anticipated, and this experiment is one of the two among the entire New York series whose results are not entirely in harmony with the others.

The case of the chinook salmon (*Oncorhynchus tschawytscha*) is yet more instructive.

Experiment 53.

New York, March and April, 1905. Six specimens which had been reared in fresh water at the New York Aquarium were changed abruptly to salt water (density during experiment 1.007 to 1.009). Result, a decrease of 2.6 per cent during first day; 3.8 per cent during 2 days; 4.7 per cent during 4 days; 6.1 per cent during 6 days.

Experiment 54.

New York, March and April, 1905. Performed as control of above. Six fishes of same lot left in fresh water and weighed to determine loss due to waste. It was found that there was a decrease of 1.6 per cent during first day; 2.6 per cent during 2 days; 4.7 per cent during 4 days; 6 per cent during 6 days.

The initial loss is thus seen to be considerably greater in the fishes transferred to even this dilute sea water. But the total loss during the first 6 days, and even during the first 4 days, is practically the same in each case. This is precisely what we should expect if the salt water were hypertonic and the membranes permeable both to water and (in lesser degree) to salts. There would result, first, a loss of weight, followed by a relative gain in weight as equilibrium was reestablished. This experiment I regard as an extremely important one from the present point of view. Accordingly I repeated it, though the density of the salt water was considerably greater at the time of the second experiment.

Experiment 55.

New York, May, 1905. (*a*) Six *Oncorhynchus* put into salt water (density 1.013). Loss 3.1 per cent during first day, 4.5 per cent during 4 days.

(*b*) Six fishes left in fresh water. Loss of 1.9 per cent during first day, 5 per cent during 4 days.

(*c*) Six fishes put into salt water (density 1.023) in a large can, without aeration. The fishes, as might have been expected, were all dead (probably asphyxiated). The loss in 1 day was nearly 12 per cent.

That water of the density 1.013 should prove hypertonic to these fishes is not perhaps surprising. But that water of density 1.007 to 1.009 should have done so (experiment 53) was, I confess, a source of astonishment, since such water has between one-fourth and one-third the salinity of ocean water.

Experiment 56.

In this experiment the water was of a density 1.007 to 1.008, and 4 fishes showed an average decrease of 3.6 per cent in 24 hours. These fishes, it is true, had had a patch of scales removed on one side, but this does not affect the result as determining whether or not the water was hypertonic. All of the fishes in this and in the three preceding experiments survived this treatment and continued to live in health as long as they remained under observation.

After making due allowance for gain or loss of weight through various accidental circumstances, in no way related to osmosis, and for the imperfections of the method employed, it seems to me to be proved by the foregoing figures that water may enter or leave the body of a fish after immersion in solutions having a different osmotic pressure from the latter. It may be questioned, however, to what extent this process is a normal one, and to what extent it is pathological. In certain cases, without doubt, it is pathological, the death of the fish resulting from, or at least being accompanied by, a considerable gain or loss of water. In earlier experiments it was found that *Fundulus heteroclitus* sooner or later died from the effects of fresh water. It may be objected, therefore, that any osmotic change occurring in this fish when placed in fresh water must be classed as pathological. I do not think that this conclusion is a necessary one, for the following reason: Both the gain and subsequent loss in weight occur long before any ill effects are manifested, and if the fishes are removed in time to their normal medium no harm will have resulted. In any case such objections do not apply to most of the other experiments with this species, nor do they apply to any of the experiments with the salmon, nor probably to either of those with the white perch.

A few words are likewise necessary in reply to another possible criticism of my interpretations. It may be asked, may not the increase or decrease in weight be due to water being taken in or passed out of the alimentary canal?[a] Have we necessarily to do with osmotic phenomena at all? While the former possibility has not been absolutely excluded, and could not be excluded, save by ligaturing both ends of the alimentary canal, I have very strong reasons for rejecting it. In the first place, there is strong a priori improbability that the effects of osmotic action should be so closely paralleled in any other way. Why should a fish from salt water swallow fresh or brackish water, and why should a fish from fresh or brackish water pass out a part of its intestinal contents when placed in salt water? And why should this latter initial loss be followed by a relative gain, as shown by experiments 53 and 55?

Yet more definite evidence on this question is furnished by certain experiments described in the next section. It is there shown that salts pass from the body of a salt-water fish when placed in fresh water. It is likewise shown that the entire contents of the alimentary canal (indeed the entire viscera of the fish) are not adequate to furnish as much salt as leaves the body in the course of a few hours. It seems probable that the water enters or leaves the body along the same path as do the salts, that path being through one or more of the bounding membranes. Other experiments show that in some fishes, at least, the gills are the organs chiefly concerned.

As before stated, the results of certain experiments at Woods Hole failed to conform to those previously obtained. This is not true, however, of all these later experiments, although as a whole the results are certainly not as clear-cut and unvarying as in the New York series. The only really serious difficulties to be encountered relate to the behavior of *Fundulus majalis*. Description of these experiments will accordingly be deferred until after the others have been considered.

Eight experiments with *F. heteroclitus* are included in this later series.

Experiments 57–64.

Woods Hole, July and August, 1905. Out of 4 experiments in which fishes were transferred to fresh water, an average gain of about 1 per cent (in ¼ to 1 day) was shown in 3 cases; in the fourth case, however, a loss of 1.5 per cent is recorded.

In 2 experiments in which water of density 1.001 was used, a gain of about 1 per cent in each case was likewise recorded.

Of 7 lots which were put into water of density 1.009, 3 showed a gain (in 1 case as high as 2 per cent), and 3 a loss, while 1 remained stationary. These figures may indicate a relative average gain, since 4 lots of control fishes, kept in sea water (1.023), together with 6 lots kept in water of density 1.013, and 1 in water of density 1.018, all, without exception, showed a loss. It is to be noted that the loss in the 1.013 water was about the same as that in the full strength sea water.

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[a] This criticism has been made by Bottazzi and Enriques (1901) of the weight determinations of *Aplysia* by Quinton (1900).

Experiments 65–68.

Four sets of experiments with *F. diaphanus* may be briefly summarized. The fishes came from Tashmoo Pond, which had, at the time, a density of 1.002, and were kept at the laboratory in running water of the same specific gravity.

In 1 case, in which these fishes were transferred to fresh water, the normal loss through waste is the only change to be recorded, but here the difference in density was of course slight.

In 3 cases the fishes were transferred to sea water, a decided loss following in each case, averaging 9.3 per cent in from 12 to 20 hours. In one of these experiments the fishes, after losing 10 per cent of their weight in 20 hours, were found to gain again. Four of the fishes here used were removed in a dying condition, but the remainder gained 6 per cent during the following day, at the end of which they appeared to be in a perfectly healthy state, and might have lived indefinitely. This is the only case in which the changes during the second day were followed with this species, but the percentage of increase is too great to be accidental. It is, moreover, what would result if two fluids of different osmotic pressure were separated by an elastic membrane, permeable to water and (though in less degree) to the salts in solution.

In one of the foregoing experiments the fishes, after 12 hours in salt water, were transferred to fresh. There followed a gain of 9 per cent, this being greater than was the initial loss in this case. This experiment is interesting in comparison with another one (66, *d*), in which fishes that had lived for 8 days in salt water were transferred to fresh. No gain whatever resulted. The fishes had reached a new equilibrium, and the normal tension of the membranes had been restored. It is none the less surprising, in view of other experiments, that no endosmotic flow of water here occurred, for, as will be shown later, fishes of this species have a considerably greater salt content after a sojourn of some days in salt water. It might therefore have been expected that they would conduct themselves, in relation to fresh water, just as do the other salt-water species employed in the preceding experiments.[a]

In 2 cases in which the fishes were transferred from the 1.002 water to water of density 1.013 there was no significant loss, in a third case there was a loss of about 3 per cent in one-half day.

Transfer from water of the above density to fresh (experiment 66, *e*) led to no increase. On the contrary, a decrease of over 3 per cent is recorded.

In most of these experiments with *F. diaphanus*, the changes did not appear to result in any harm to the fishes, and can not therefore be regarded as pathological. Even when the change was made from the faintly brackish water in which they lived to full strength sea water no deaths had occurred at the time of the second weighing, in 2 cases out of 3. Indeed, the fishes in these 2 cases all remained in perfect health for another 24 hours, after which they were returned to their normal medium. Thereafter no deaths occurred (with one possible exception) for 4 days more, after which the fishes were no longer observed. The fishes used had been "seasoned" for a long period in the laboratory, and a large majority would survive indefinite transfer to sea water (see p. 67).

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[a] In a repetition of this experiment the fishes showed a gain of 2.5 per cent in one day, but in this case 2 had died.

Experiments 69-71.

> Six scup, weighed separately, were found to have gained to a scarcely appreciable extent if weighed immediately after death. If allowed to remain long in the water, however, the gain was much more pronounced.

In interpreting the foregoing figures it must be borne in mind that these experiments were made during the summer months when metabolism in general was more active, and when the loss of weight through waste, in these unfed animals, was consequently more rapid. Owing to this fact, and probably, also, to the discharge of matters from the reproductive organs, such accurate determinations of gain or loss in weight as were previously made were here found to be impossible. It will be seen by reference to the above notes that in no case has a gain been recorded where it would not have been expected according to hypothesis. On the other hand, loss or stationary weight is recorded in some cases where a gain might reasonably have been expected. The discharge, at any time, of eggs or of ovarian fluid from one or more of the fishes in a given lot might well have produced some of these aberrant results. This, of course, was not likely to occur during the winter and early spring.

Even such allowances do not seem sufficient, however, in the case of *Fundulus majalis*, as the following experiments show:

Experiments 72-76.

> Of five lots transferred to fresh water two showed a considerable gain, but in both of these cases the fishes had begun to die, and dead fishes rapidly imbibe water, as has already been pointed out. In a third case a slight (scarcely significant) gain is to be noted. In a fourth lot there was an initial loss of about 1 per cent during the first 12 hours, followed by a gain of more than 2 per cent during the next 12 hours. But it is to be noted that in this case the control fishes in salt water likewise showed a loss during the first half day, followed likewise by a slight gain. In the fifth fresh-water lot a loss was recorded at the end of the first day, as well as at the end of the first half day, the total loss amounting to about 3 per cent, while that of the control lot amounted to only a trifle over 1 per cent.
>
> Of the five lots put into 1.001 water, three were found to have lost during the first half day, and likewise throughout the entire day, the total loss amounting in each lot to more than that shown by the control fishes in salt water. The other two lots gained during the first half day, but lost during the second.
>
> Of the control fishes, three lots lost, one remained stationary, while one first lost and then gained slightly.

Had I begun my experiments in weighing during the summer and used *Fundulus majalis* at the outset, it is likely that I should have despaired of discovering any significant changes in weight, and, indeed, it may appear to the reader that such figures as have just been recorded may well have been due to accident or error. I will promptly add that I can not myself satisfactorily explain these differences in my results.

It must be urged at the outset, however, that these aberrant cases in no way invalidate the results of my earlier experiments. From the earlier series we are forced to conclude that certain changes of weight may occur as the result of osmotic action. Some of the later experiments show that under different conditions such changes may not occur. The only differences in the conditions, so far as I am aware, relate (1) to temperature (20° to 22° C. at Woods Hole, 3° to 15° C. at New York) and (2) to the previous history of the fishes used. Those employed at the New York Aquarium had been living in water of density 1.007 to 1.012, those at Woods Hole (i. e., the salt-water ones) in sea water of nearly or quite full strength. I can not believe, however, that this was a significant factor in the case.

It is well known that osmotic pressure varies with temperature. In the present case, however, it seems to be a difference in the permeability of the membranes that demands explanation. During the summer months metabolism in general is of course more active, and various chemical and physical changes are in progress which are dormant during the colder season. It is not unlikely, therefore, that the osmotic permeability of a fish, always dependent upon the physiological condition of the animal, should present considerable differences during the summer and winter months. This being granted, it remains to be asked just what changes in permeability would account for some of these aberrant results. In certain of the foregoing experiments with the three species of *Fundulus*, where a decided gain was to have been expected in view of earlier results, a decrease was found to have occurred instead. Assuming that this decrease is attributable to normal waste as in the case of fishes left in their customary medium (or to some other irrelevant circumstance, see p. 80), how are we to account for a stationary weight in a strongly hypotonic fluid? As has already been stated (p. 70), a stationary weight in a medium which is not approximately isotonic may mean either (1) that the membranes are impermeable to water; or (2) that water and salts may pass through with equal freedom, in which case the conditions for osmosis are wanting. The latter alternative does not necessarily imply a freely porous state of the membranes, such as obtains in the case of a filter. It is quite conceivable that this indiscriminate permeability of the body surface should be subject to the controlling influence of the organism, just as we know that the differential permeability, which renders osmosis possible, may be so controlled. I have thus emphasized this second possibility, inasmuch as I regard the first one as being thrown out of consideration in certain cases. Although no unquestionable change in weight resulted in either *F. majalis* or *F. diaphanus* when transferred from salt to fresh water, I shall later show that a decided change occurred in both cases in the salt content of the body. It will likewise be shown to be highly improbable that this salt passed from the body by way of the alimentary canal or the reproductive organs, leaving as the only alternative a diffusion through one or more of the limiting membranes of the body.

In some other cases, on the contrary, the facts are best explained by assuming a condition of complete impermeability, as in the case of *F. majalis* when transferred from salt to slightly saline water. Here no certain increase in weight occurs, and there is apparently no decrease in the salt content of the body. (See experiment 103).

Bert (1871) has noted that a goldfish dying in salt water lost about one-fifteenth of its weight, if the specimen were a small one. The loss was insignificant, on the other hand, if the fish weighed several hundred grams. These fishes died, on the average, in an hour's time, a period not long enough to permit of any extensive loss, just as no considerable gain was found to occur in the case of the scup dying in fresh water (experiments 69-71), above. Loaches and young eels, according to Bert, lost one-tenth or even one-sixth of their weight; but both of these fishes have a naked skin. In all of Bert's experiments the results of the changes were fatal, and the phenomena were hence pathological.

Fredericq (1904) records that the blood plasma of elasmobranchs increases in volume in more dilute sea water, decreasing in less dilute. Of course a gain or loss of weight would be entailed thereby. According to Fredericq, however, the conditions which obtain in sharks relative to osmosis are radically different from those which hold for the teleosts.

Various authors have described weight changes, due to osmosis, in the case of invertebrates, but these need not be considered here.

CHANGES OF WEIGHT IN DEAD FISHES.

It has been noted that many of the fishes used in the foregoing set of experiments died from the effect of the change of medium, and it likewise appears from the records that in those cases in which death occurred the gain or loss was usually much greater in a given time than in those cases where no harmful effects were apparent. Compare, for example, experiment 81 or 41 *b* with 41 *b'*; also experiment 41 *e* with experiment 86.[a] The catfish in experiment 49 lost over 8 per cent of their weight in 17 hours (probably 10 to 12 per cent in 1 day) and ultimately died, while the white perch (experiment 51) lost 4.7 per cent and the salmon (experiment 55 *a*) only 3.1 per cent in a day in water of somewhat greater density, these two species not being harmfully affected by the change. It is only fair to add, however, that in the case of the rudd (experiment 50), which died after transfer to salt water, a loss of only 4 per cent is recorded. This may be due, it is true, to a subsequent gain through imbibition of water after death (see below).

I had at first supposed that the determination of a solution which was isotonic with the body fluids of a given species of fish could be made simply enough by immersing dead specimens in water of various degrees of salinity and noting the effects upon their weight. A solution in which the weight remained stationary would be isotonic. As a matter of fact, however, some species were found to increase in weight in water of any specific gravity which was employed.

Experiment 77.

New York, April, 1905. The chinook salmon (*Oncorhynchus tschawytscha*),[b] the sunfish (*Eupomotis gibbosus*), and the carp (*Cyprinus carpio*) among the fresh-water species, and *Fundulus heteroclitus*, the tomcod (*Microgadus tomcod*), and the sea raven (*Hemitripterus americanus*) among the salt-water ones, were used. The more sensitive species were allowed to die out of water, while the more resistant ones were killed by vapor of chloroform. The fishes were weighed first before immersion, again after 3 to 5 hours of soaking in the solutions, and once more after another interval of about 12 hours. Seven sorts of water were employed—fresh water, and salt solutions having the densities 1.002½, 1.005, 1.010, 1.015, 1.020, and 1.025. These solutions were prepared with a commercial "sea salt." It was found that the salmon, carp, and *Fundulus* all increased[a] from the first in water of all grades. This was practically true of the sunfish and tomcod likewise, except that during the first interval there was no appreciable increase (in one case a slight decrease) in the three stronger solutions, an increase following, however, during the next 12 hours. The sea raven alone gave results which conformed in some measure with what one would expect from osmotic action. Here a loss occurred in the three stronger solutions (1.015, 1.020, and 1.025) during the first 3½ hours, this amounting to 1 per cent in the first case and 1.8 per cent in the last. Even with this species, however, there were irregularities which confused the results.

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[a] See pp. 73-74 for weight changes undergone by fishes used in experiments 81 and 86. They are not recorded in notes for those experiments.

[b] The salmon is here counted among the fresh-water species because the earlier months of its life are passed in fresh water and those specimens here used were taken from fresh water.

Experiment 78.

In this additional experiment with *Oncorhynchus*, in which fresh water and two different strengths of salt water were used (1.008 and 1.014), a gain resulted in each case, though in the third case this was not certain during the first day.

This increase in weight of dead fishes in the foregoing experiments is in striking contrast to those cases (particularly 41, *c*, and 55, *c*) in which fishes of the same species dying in strong salt water lost weight in considerable measure. The following two experiments likewise illustrate this contrast:

Experiment 79.

Specimens of the tautog, sea raven, and tomcod, which after death were put into water of density 1.014, were all found to have increased in weight at the end of 18 hours.

Experiment 80.

A living tautog put into a tub of water of about the same density lost 1.8 per cent during the first 20 hours, although death from asphyxiation occurred some time during this period. It is true that the dead fish underwent an additional decrease of about one-half per cent during the next 24 hours, but the loss of mucus through wiping the fish perhaps more than accounts for this.

The increase in weight of dead fishes in solutions which are undoubtedly hypertonic as compared with the body fluids may be explained in a number of ways. It is, of course, possible that water enters the alimentary canal at either end; or it is possible that after death the limiting membranes of the body become so completely permeable that no osmotic action is possible, and that a process of imbibition occurs, the water combining in some way, perhaps, with the dead proteids of the tissues. The latter hypothesis seems to me to be far more probable, since the gain in weight is progressive, lasting, it may be, for days, at the end of which time the fish has a decidedly water-soaked appearance.

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[a] Percentages of increase or decrease are omitted here as being of little importance for the present discussion.

Loeb (1900) in experiments with pieces of muscle, which he immersed in various solutions, found that such pieces might either gain or lose in weight in solutions which were equimolecular, but differed in respect to the salts employed. Chemical action, rather than simple osmotic action, he believed to be responsible for the influx or efflux of water.

If this explanation be applicable to the dead fishes used in my experiments, it will be seen that the attempt by Fredericq (1904) to ascertain the osmotic pressure of the fluids of the tissues of various fishes by similar weight determinations was not likely to yield reliable results, and, indeed, he admits that the figures thus obtained differed widely from those obtained by the cryoscopic method.

The case of those fishes which died in hypertonic solutions and likewise lost weight in those solutions is perhaps to be explained on the ground that the loss of weight occurred before and shortly after death, though this explanation does not seem to cover all cases (experiment 80, second day).

PERMEABILITY OF THE MEMBRANES TO SALTS IN SOLUTION.[a]

Some of the preceding experiments seem to prove conclusively that considerable amounts of water may enter or leave the body of a living fish if the latter be transferred to water of a density much lower or much higher than that to which it has previously been accustomed. That in all probability this water does not enter or leave the body by way of the alimentary canal has already been noted, in anticipation of results to be discussed later. There is thus left, as the most likely alternative, an osmotic passage through one or more of the membranes bounding the body. It has been shown, likewise, that these changes occur, in many cases, without apparent harm to the fish.

The question next to be discussed is whether or not salts in solution may likewise diffuse through these membranes. If the gain or loss of weight shown in the preceding experiments be due to osmotic action, it is of course impossible that the passage of salts should occur as readily as that of the water. Does it occur at all?

This problem I have attacked from both sides. In the first place, the passage of salts (strictly speaking, of chlorides) into fresh water from fishes taken from salt or brackish water was tested chemically. In the second place, the salt content of the tissues of various fishes which had lived in water of various degrees of salinity was likewise determined. It will be found that the results from these two methods present some striking points of agreement. The former method will be discussed first, although the results are as a whole less satisfactory than in the second case.

DETERMINATIONS OF THE CHLORINE PASSED INTO THE WATER BY THE FISHES.

Fishes of known weight taken from salt or brackish water were transferred to known volumes of fresh (in a few cases of distilled) water. The fishes were, in all cases, given a preliminary rinsing (10 to 30 minutes) in fresh water before being placed in the water to be tested. This was obviously necessary in order that all salt water adhering to the surface should be removed. They were weighed without any preliminary drying, such as was necessary when very accurate weight determinations were required. Except in a few cases, the fishes used had been kept unfed for 3 or more days prior to the experiment.

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[a] I have spoken throughout of *salts* rather than *ions*, because I can not see the advantage for present purposes, of following the language of the electrolytic dissociation hypothesis.

The chief difficulty which beset this method of procedure was the fact that the fishes had to be kept in comparatively small volumes of water. Aeration was in many cases effected by the use of tanks of compressed air, but, even thus, many of the fishes were overcome by asphyxiation before the experiment had proceeded far. In such cases we may feel sure that the osmotic phenomena were not wholly normal. These complications, however, are indicated in the records cited below, where due allowance is made for them.

My reasons for taking the amount of chlorine as an index of the quantity of salts passing from the fish are obvious: (1) The test is an extremely simple one: (2) the chlorides (sodium chloride and magnesium chloride) together form more than 88 per cent of the entire saline ingredients of sea water.[a] The bromine, which reacts like chlorine to the silver test, may be omitted as too insignificant in amount. The test employed by me was Mohr's silver nitrate titration method. According to this, a given volume of the solution to be tested is first tinted yellow by the addition of a few drops of a solution of neutral potassium chromate. Silver nitrate solution of a given strength is added from a burette until, after all of the chlorine has been combined as silver chloride, any excess of silver is free to combine with the chromic acid. At this point an abrupt change of color results, due to the appearance of the red silver chromate. The amount of chlorine present is of course readily computed from the amount of silver employed.

For the determinations here recorded I do not claim any very high degree of accuracy. Nor was this either necessary or possible under the circumstances. In general, the larger the proportions of chlorine the more exact are the figures. Where the amount was slight, however, the determination was more difficult, and it is probable that my figures in such cases are commonly too high. Again, in those cases in which death occurred and decomposition commenced, the presence of various organic matters in the water obscured the reaction. In such event the solution was sometimes evaporated and the residue charred.

Allowance was made in all cases for the quantity of chlorine already present in the fresh water used, this being about 0.003 gram per liter.

Experiment 81.

> New York, May, 1905.[b] Ten *F. heteroclitus*, of aggregate weight 110.3 grams, taken from water of density 1.013, were put into fresh water. Percentages of chlorine passed out (i. e., amounts per 100 grams of body weight) were 0.008 during the first hour, 0.030 during first day, 0.041 during 2 days. At the end of this period the fishes were all in seemingly normal condition.

In this experiment several facts of interest are to be noted: (1) A quite appreciable amount of chlorine passed from the bodies of the fishes during the first hour. (2) The amount passing out during the entire first day is less than four times the amount during the first hour, and similarly only 37 per cent more passed out during two days than during the first day alone. Thus the loss of chlorides from the body occurs at a steadily diminishing rate. This conclusion is confirmed by all the succeeding experiments.

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[a] Dittmar (1884), in his hypothetical formula for the "proximate composition" of sea salts, gives the percentage of NaCl as 77.758, that of $MgCl_2$ as 10.878. In whatever combinations it may actually occur, however, the percentage of chlorine is given by him as 55.292.

[b] This entire series was carried on during May and June of 1905 at the New York Aquarium.

> *Experiment 82.*
>
> Fishes with same history as last. About twice as much chlorine was recorded for the first hour. An accident prevented further determinations.
>
> *Experiment 83.*
>
> *F. heteroclitus*, which had been in water of density 1.005 (1.004 to 1.006) for 5 days, and were taken originally from a salt-water tank (1.013): 0.036 gram per 100 in 1 day, 0.051 gram per 100 in 2 days.
>
> *Experiment 84.*
>
> Same species, with same history: 0.022 gram per 100 in 1 day, 0.025 gram per 100 in 2 days.
>
> *Experiment 85.*
>
> Same species from same tank originally, but in 1.005 water 10 days: 0.034 gram per 100 in 1 day, 0.044 gram per 100 in 2 days.
>
> In each case the fishes were well at the end of the second day of the experiment.

Experiments 83 and 85 agree fairly closely, but experiment 84, for some unknown reason, shows a much smaller loss of chlorine. The mean results of these three experiments are 0.031 gram per 100 in 1 day; 0.040 gram per 100 in 2 days. In experiment 81 these figures were 0.030 and 0.041, respectively—i. e., there is a practical identity between the two sets of figures. Where such great variations occur as in the above results the mean of a large number of determinations should of course be taken. Provisionally it may be concluded, however, that fishes from water of density 1.005 will yield about as much chlorine in fresh water as fishes from water of density 1.013.

> *Experiment 86.*
>
> In this case the fishes had been kept 3 days in water of density 1.023 before the commencement of the experiment (originally from 1.013). Results: 0.015 gram per 100 in 1 hour, 0.042 gram per 100 in 1 day.
>
> The figures are larger than any of those previously given.

In order to test the possibility that the chlorides thus found had left the body by way of the alimentary canal or reproductive organs, the following control experiment was performed.

> *Experiment 87.*
>
> Ten fishes having the same history as those used in the preceding experiment were killed, and from them were taken the entire alimentary canals and the gall bladders, testes, and ovaries. These were cut into fine bits; then macerated 15 minutes or more in fresh water. This latter was found to yield 0.005 gram chlorine. Thus this lot of fishes, weighing 106 grams, could have furnished from the contents of their alimentary canals and reproductive organs not more than five thousandths of a gram of chlorine, and probably much less than this.

It will be seen by reference to experiment 86 that three times this amount of chlorine (per 100 grams of body weight) was yielded by the living fishes in a single hour. A number of confirmatory experiments are recorded later.

Experiments 88 and 89.

Fishes (*F. heteroclitus*) were used which had been kept in fresh water for 4 and 5 days, respectively. The mean yield of chlorine during the first day in these two cases was 0.016 per 100 grams weight of the fish.

This figure was surprisingly large, being somewhat over one-half the quantity yielded during the first day by the fishes from the 1.013 water, and considerably greater than that yielded during the second day by the latter. The present fishes, it will be remembered, had already spent 4 or 5 days in fresh water. It is to be noted, however, that in each of the present experiments one or more of the fishes had died before the chlorine test was made, and that dead fishes yield up their salts more readily than living ones.

Several experiments were made with the tomcod, a fish which will, under favorable conditions, survive the abrupt transfer to fresh water, and live for considerable periods in the latter medium. Great difficulty was found, however, in maintaining sufficient aeration.

Experiment 90.

Here 3 tomcods, weighing 116 grams, were placed, after the preliminary rinsing, in 40 times their weight of fresh water. Results: 0.027 gram chlorine per 100 in 6 hours, 0.049 gram chlorine per 100 in 1 day.

The fishes were all well at the end of the first 6 hours. At the end of a day 1 fish was found dead (death probably quite recent).

Experiment 91.

This was a control experiment similar to experiment 87. In this case all of the viscera were removed, chopped up and macerated, and the body cavities, containing more or less blood, were rinsed out, the water so used being added to the rest. Even in this case the quantity of chlorine thus yielded was only 0.010 gram for each 100 grams weight of the fish.[a]

This is seen to be only a little more than one-third the amount passing from the living fishes in the course of 6 hours. It can not be seriously maintained, then, that any large part of the salts which were found in the water had left the bodies of the fishes by way of the alimentary canal. That it passed out through the organs of excretion might be argued with somewhat greater plausibility.

In two other experiments in which this species was employed the aeration was quite insufficient and the fishes soon began to die in consequence.

Experiment 92.

Two of the fishes had died during the first hour, and the proportion of chlorine passed out during this period was 0.021 per 100 grams. Here the phenomena were of course pathological.

Experiment 93.

Death did not occur so soon, and the figure for the first hour was very much lower.

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[a] The original weight of the fish used is of course intended here, not the weight of the viscera from which the salts were extracted.

Experiments 94, 95, and 96.

These experiments, dealing with sea raven (2 cases) and sea bass, will be briefly mentioned, though I attribute far less importance to them, since fresh water is soon fatal to both of these species and we are hence not dealing with normal phenomena. In the case of one sea raven transferred to fresh water, the loss of chlorine was 0.018 per 100 grams during the first hour and 0.028 during first 2 hours. Death probably occurred not long after this.

Another sea raven was placed in distilled water and death occurred in about 2 hours. Up to this time 0.039 gram chlorine per 100 had passed out. Here and in the preceding case almost the entire epidermis was sloughed off, even before the death of the fish.

A sea bass yielded 0.012 gram per 100 during the 40 minutes which elapsed before death.

The most instructive cases should be those of fishes which in nature live in either medium, and may be transferred with impunity from one to the other. The chinook salmon is of course such a fish, and experiments were attempted with this species, specimens being used which had previously lived 4 days in salt water. It was found impossible, however, to keep up sufficient aeration in the limited volumes of water employed, and the fishes died quickly. The white perch (*Morone americana*) is a much more favorable subject for such experiments. It has already been noted (p. 60) that perfectly healthy specimens will, in many cases at least, survive transfer to fresh water. For example, two of the same lot as used below were put into running fresh water and remained in good health for four days, when they were removed for other purposes. This alone would not of course be fully conclusive.

Experiment 97.

Two white perch from salt water (density 1.015), unfed for 2 days, after preliminary rinsing put into separate jars, each containing fresh water 40 times the weight of the fish. Mean results for 2 fishes, 0.036 gram chlorine per 100 in 1 day, 0.058 gram chlorine per 100 in 2 days. Both of these figures are considerably higher than the ones for *F. heteroclitus.*

The fishes at the end of the first day were in perfect health. By the end of the second day aeration had stopped and both fishes were dead.

Experiment 98.

The control experiment of extracting the salts from the viscera was performed once more with fishes having the same history as the preceding. Not only were all of the viscera removed and the body cavities rinsed, but the former were boiled for 15 to 20 minutes. It was found that the chlorine derived from all of these sources was (in proportion to the weight of the fishes used) considerably less than two-thirds as much as passed from the body in a single day and only about one-third as much as passed from the body in 2 days.

This does not of course entirely dispose of the objection that the salts may leave the body in the excretions of the kidneys.

It remains to be considered whether chlorine in appreciable quantities is given off by fresh-water fishes while in their normal medium. It will be remembered that in experiments 88 and 89 some *F. heteroclitus* which had been living in fresh water for some days were found to pass out about half as much chlorine in a day as did the fishes recently taken from salt water. In qualification of these figures it will be recalled (1) that small amounts of chlorine were apt to be overestimated, and (2) that in each of these two experiments one or more of the fishes had died.

> *Experiment 99.*
>
> A catfish (*Ameiurus nebulosus*) was found to pass out during 19 hours 0.004 gram chlorine per 100.[a] This is thus between one-eighth and one-seventh the first day's output of *F. heteroclitus* from salt water.
>
> *Experiments 100 and 101.*
>
> These experiments, in which carp were used, are decidedly puzzling. The output of chlorine per 100 grams of body weight was in one case 0.009 gram in 5 hours, in another it was 0.015 gram in 16 hours.

Since these fishes had not been fed for 10 and 13 days, respectively, the salts here indicated can not have been passed out in feces. I can only mention, by way of possible explanation, that the fishes here used had been living in fresh water which received a slight, though undetermined, admixture of salt water. It will be shown below that even very small proportions of sea water have a pronounced effect upon the salt content of the body.

It will be better to defer any general discussion of the foregoing results until the analyses of the bodies of the fishes themselves have been considered. Certain doubts which the reader may have formed regarding the significance of the preceding figures will then perhaps be dispelled.

Experiments in which the fishes died, or in which they were killed and returned to fresh water, seem to show (1) that a dead fish will yield a larger proportion of its salts than a living one, but that (2) there is no sudden increase in the diffusion of these after death. These conclusions were not tested very thoroughly by experiment, however, and they are hence only offered provisionally.

DETERMINATIONS OF THE CHLORINE IN THE TISSUES OF FISHES.

Each lot of fishes here used was first rinsed in fresh water for 5 to 10 minutes in order to remove any salt water which might adhere. They were then weighed, after which the entire fishes were cut up into fine pieces and placed in a porcelain evaporating dish or crucible. Considerable quantities of a mixture of equal parts of sodium (or potassium) nitrate and sodium carbonate were now added in order to facilitate combustion, and the whole mass was heated to the point required for ignition. It was, of course, necessary that all chemicals used should be chlorine-free, and it was likewise necessary to avoid any contamination of materials with salt water.

The soluble salts were extracted from the residue with boiling water. The resulting solution was first treated with nitric acid to transform any phosphates present, and then rendered neutral with calcium carbonate. After filtration the solution was titrated with silver nitrate according to the method already described. If care had been taken to insure the complete combustion of all organic matters, the determination was simple and fairly exact.

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[a] This figure is probably too high (see p. 85).

One source of error in this method is the loss of a certain portion of the chlorides through volatilization. This loss is probably slight, however, and in any case the error was likely to be a nearly constant one throughout, leaving the relative values unaffected.

Since it was thought possible that differences in the bodily salt content of the fishes used might depend upon differences in the water contained in their alimentary canals, certain tests were made with fishes from which the latter had been removed. The results of such experiments were such that this procedure was not thought to be worth while.

Let me add that I have presented here the figures for all of the analyses made by me, no discordant results being suppressed.

Experiment 102.[a]

(*a*) Five *F. heteroclitus* from a lot which had been kept unfed for some weeks in water of density 1.023 were tested together. The alimentary canals, livers, and gall bladders were removed, and the fishes were weighed after the removal of these parts; thus the percentage of chlorine given represents the proportion found in the eviscerated bodies. The percentage was here 0.167.

(*b*) Five fishes from same lot were kept in fresh water for 1 day. The subsequent treatment was the same. Percentage of chlorine 0.129.

(*c*) Five fishes (from another lot) were kept in 1.001 water[b] for 1 day. Alimentary canals, etc., removed as above. Percentage of chlorine 0.123.

(*d*) Eight fishes (same lot as last) kept in 1.002 water (see table on p. 96) for 1 day. Percentage of chlorine 0.159.

It would thus appear that in fresh water about 23 per cent of the total chlorides of the body passed out during a single day. Let it be recalled that in experiment 86, in which the fishes used had been kept in water of the same density as those here employed, it was found that the loss of chlorine was 0.042 gram per 100 grams of body weight. Assuming the original percentage of chlorine to have been the same as in the present experiment (0.167), the fishes in experiment 86 lost about 25 per cent of their chlorine. Thus the results reached by these two methods are found to be in striking agreement. It would be rash, however, to expect such a close correspondence in every case.

The effect of the 1.001 water was practically the same as that of fresh water, the difference of 0.006 per cent in the analyses probably having no significance. On the other hand it is a fact of the highest interest that fishes in the 1.002 water lost little if any of their chlorides. It would thus appear that the degree of dilution which may be endured with impunity by this fish lies somewhere between these two limits.

Experiment 103.

Fundulus majalis was here used, two fishes being taken for each analysis. The digestive tracts, etc., were not removed.

(*a*) Fishes from salt water (1.023). Percentage of chlorine 0.179.

(*b*) This lot, originally from salt water, had spent 2 days in water of density 1.001 (approximately). Percentage of chlorine 0.178.

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[a] All of this series were done at Woods Hole during August, 1905.

[b] The water here used gave a salinometer reading (corrected) of about 1.001. A chemical analysis of water giving this reading, however, showed that it contained only 3 per cent as much chlorine as the local sea water.

(*c*) Had spent 1 day in fresh water. Percentage of chlorine 0.126.

(*d*) Fresh water 2 days. Percentage of chlorine 0.129.

It will be noted, first, that the lot from salt water showed a percentage of chlorine not very different from that of *F. heteroclitus* (preceding experiment). Second, the percentage was practically the same in the fishes from water of density 1.001 as in those from pure sea water; while third, fishes which had spent one day in fresh water showed a loss of 30 per cent of their chlorine. Fourth, there was practically no difference in this regard between those which had been in fresh water 1 day and those which had been there for 2 days.

The second of the results just enumerated is rather surprising, in view of the fact that *F. heteroclitus* was found to yield up a considerable fraction of its chlorine in water of approximately the same density (1.001±), though retaining it in water of density 1.002. Whether this difference of results is due to any real physiological difference between these two species may be doubted. Where the water is so near to what may be called the critical degree of salinity, a slight difference in one direction or the other might suffice to produce a very considerable difference of results. It was previously found (experiments 31, 31 bis) that water of density 1.001 was slowly fatal to *F. majalis*, while water of density 1.002 effected little or no harm.

Despite minor discrepancies, the last two experiments agree in showing a great difference between the effects upon the chlorine content of the body of pure fresh water and water having a certain small percentage of salt. This difference is extremely significant in view of the difference, already discussed, in their effects upon the life of the fishes.

In another series of experiments (104–107) *F. diaphanus* was used. These fishes had been taken in Tashmoo Pond, in water of density 1.002, and kept in the laboratory unfed for a number of days prior to the experiment in water of the same density. Analysis of this water showed that it contained 7 per cent as much chlorine as the local sea water. The entire fishes were used for analysis, the alimentary canals, etc., not being removed. The specimens were first rinsed thoroughly, here as always.

Experiment 104.

Five different analyses were made with fishes taken directly from the brackish water (1.002). In each case 4 fishes were treated together. These analyses gave the following percentages of chlorine: *a*, 0.175; *b*, 0.136; *c*, 0.128; *d*, 0.139; *e*, 0.132. The mean of these figures is 0.142.

It will be seen that with the exception of *a* these figures do not present a wide variation. I regard the first result as probably due to an error, both on account of the exceptionally large amount of chlorine indicated and because the test was not a very satisfactory one. Strict fairness compels its insertion here, however. The mean of the other four figures is 0.134, and this figure, being in my mind the more probable one, will be used in subsequent comparisons. The reader is at any time free to substitute the other figure.

Experiment 105.

Here the fishes were kept in fresh water for a varying period prior to the analysis.

(*a*) 1 day (4 fishes)	0.112
(*b*) 3 days (4 fishes)	0.108
(*c*) 11 days (8 fishes)	0.085

In 1 day the fishes lost over 16 per cent of their chlorides; in 11 days nearly 37 per cent. As I have previously pointed out in discussing the analyses of chlorine in the water, the loss of salts from the body takes place at a diminishing rate. In the present case nearly as much passed out during the first day as during the next 10 days.

Experiment 106.

Fishes kept in salt water.

(*a*) 1 day (4 fishes 0.181	mean.. 0.188
(*a′*) 1 day (4 fishes 0.196	
(*b*) 5 days (2 fishes)	0.143
(*c*) 10 days (3 fishes)	0.151

For the rather anomalous fact that in two different tests the 1-day fishes gave much higher percentages of chlorine than the 5 or the 10 day ones, I will offer the following explanation: (1) As shown above (experiments 65–68), the immediate result of the immersion of these fishes in salt water is a loss of water amounting in 1 day to about 10 per cent of their weight. This would of course result in a higher concentration of the solutions in the body. It was found, however, that part at least of this loss of water is made up later. (2) A certain (often a large) proportion of these fishes succumb within a few days after transfer to salt water. It is quite possible, therefore, that the lots analyzed included individuals which would soon have died and thus had undergone greater changes than normal fishes would have done. Those, on the contrary, which had survived 5 or more days in salt water were probably individuals that had not been harmed by the change and would probably have lived indefinitely.[a]

Omitting the figures for the fishes which had passed 1 day in salt water, it will be seen that those for the other tests fall into a very suggestive series.

Fresh water	11 days	0.085
	3 days	0.108
	1 day	0.112
Brackish water (1.002)		0.134 [or 0.142]
Salt water	5 days	0.143
	10 days	0.151

It will be seen that the last of these figures is about 78 per cent greater than the first. It will be seen likewise that whichever figure be regarded as the more correct one for the brackish-water fishes, the latter agree much more closely with the salt-water than with the fresh-water individuals (the comparison being of course with the extreme members of the series).

Experiment 107.

Eight fishes kept in water of density 1.013 for 7 days. The percentage of chlorine for this lot was 0.134, i. e., the same as for those kept in brackish water.

It was thought desirable to test some species which in nature inhabits fresh, brackish, and salt water equally well, using individuals from each of these sources. The white perch (*Morone americana*) seemed likely to be a favorable object for such studies. The following experiments, however, show a high range of variability in the individuals used—much higher than in *F. diaphanus*.[a] Hence the results are somewhat less decisive. Owing to a scarcity of material, it was found necessary to use fishes of very different sizes, but this fact certainly does not account for the variations in the proportion of chlorine.

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[a] Another explanation of this apparent anomaly was suggested to me by Prof. W. C. Sabine. It is quite possible that after the first shock of change, resulting in considerable osmotic disturbances in the body of the fish, an effort would be made by the latter to reduce its salt content to the original (normal) level, the excess or part of it being eliminated by way of the organs of excretion.

Experiment 108.

> *Morone* from Tashmoo Pond (1.002) kept for some days (unfed) in water of same density in laboratory before being used for experiment. One small specimen used for each test. (*a*) Percentage of chlorine, 0.116; (*b*) percentage of chlorine, 0.135; (*c*) percentage of chlorine, 0.151; mean, 0.134.

This mean figure, it will be recalled, is identical with that for the *F. diaphanus* from this same water. In view of the great range of variation here, however, such precise agreement is doubtless due to chance.

Experiment 109.

> *Morone* from Lagoon Pond (head of Vineyard Haven). A water sample taken near shore gave a reading of 1.016, but it is likely that the water in which the fishes lived was considerably more saline. The fishes were kept in the salt water of the laboratory (1.023) 1 and 2 days, respectively, before the analysis. One fish was used in each experiment. (*a*) Percentage of chlorine, 0.136; (*b*) percentage of chlorine, 0.142; mean, 0.139.

The difference of this figure from that of the brackish-water specimens is perhaps not great enough to be significant. Strict candor compels me to record the analysis of another fish from this source, which appeared to contain only 0.101 per cent of chlorine. This figure falls so far below all others obtained from this species, however, that I can not but regard it as due to an error. If this analysis were included with the foregoing, the average would become 0.126.

Experiment 110.

> Fishes from a fresh-water pond (landlocked). The water of this pond, though fresh to the taste, was found to contain 0.051 gram chlorine per liter, or about 18 times the proportion in the fresh-water supply of New York City. One fish was used in each test. (*a*) Percentage of chlorine, 0.112; (*b*) percentage of chlorine, 0.130; mean, 0.121.

Were there no other facts upon which to base conclusions, it might be objected that the differences in salt content of these fishes from various sources might be due to differences in their food and not to any osmotic relations between the animals and the surrounding water. Such an objection is of course inapplicable to the foregoing experiments with the various species of *Fundulus*. It is likewise out of question as regards the next two experiments with *Morone*. Here fishes coming originally from brackish water were analyzed after a stay of some days (unfed) in salt or fresh water in the laboratory.

Experiment 111.

> Fishes from Tashmoo Pond were kept 6 days in water of density 1.023 before the analysis. In the second of the two specimens used the alimentary canal was removed. (*a*) Percentage of chlorine, 0.136; (*b*) percentage of chlorine, 0.162; mean, 0.149.

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[a] Owing, perhaps, to the fact that in the case of the latter species a number of specimens were used at a time, thus tending to level down individual differences.

This figure is somewhat greater than that for the fishes taken from a somewhat diluted sea water (experiment 109). It will be noted that the second fish gave a very much higher percentage of chlorine, in spite of the removal of the alimentary canal. The contents of the latter, therefore, played no part in determining the amount of chlorine present.

Experiment 112.

Fishes from Tashmoo Pond, kept 5 days in the fresh water of the laboratory prior to analysis. In the first case, 1 fish was used, in the second 2. In *b*, the alimentary canals were removed. (*a*) Percentage of chlorine, 0.120; (*b*) percentage of chlorine, 0.109; mean, 0.114.

This figure will be seen to be somewhat lower than that for the fishes from the fresh-water pond (experiment 110), but in view of such large variations it would be absurd to draw any conclusions from this fact.

If, on the one hand, the mean figure for the *Morone* from the fresh-water pond is averaged with that for those kept in the laboratory fresh-water for 5 days; and if, on the other hand, the figure for the Vineyard Haven fishes is averaged with that for those kept in the laboratory salt water, the figures thus obtained, together with that for the brackish-water fishes, may be arranged in the following series:

(*a*) Fresh-water specimens	0.117
(*b*) Brackish-water specimens	0.134
(*c*) Salt-water specimens	0.144 [or 0.137]

The figure for the "fresh water" fishes is thus 19 per cent [or 15 per cent] less than that for the "salt water" ones. It was found in experiment 97 (also with *Morone*) that 0.036 gram chlorine per 100 grams body weight was given out in the course of a single day. Assuming the percentage of chlorine originally present to have been 0.144 it would appear that 25 per cent of the chlorine of the body was lost in a single day. Here, then, the figures obtained by the two methods are not in full accord.

It may be regarded as abundantly proved by the preceding experiments that some species of fishes, at least, undergo considerable changes in the salt content of their bodies in consequence of changes in the salinity of the surrounding water. These changes are fairly rapid, resulting, at times, in differences of 25 per cent or more in a single day. Moreover, they do not necessarily result in any harm to the animal. It is plain, however, that these changes in the bodily salt content are in no way proportional to the changes in the salinity of the medium. Indeed, very great alterations in the latter may sometimes be made without any apparent effect upon the former. (Experiments 103, *b*, and 107.) The exact extent of the correlation between the two might be determined by a sufficient number of analyses, but it is quite unlikely that it could be expressed by any single mathematical formula. This is because fishes do not conduct themselves as simple dialyzers.

Whether or not all of the tissues are equally affected by these changes in the bodily salt content I can not say. The body as a whole loses or gains in its proportion of salts (chlorides), and these leave or enter it by some path other than the alimentary canal. The occurrence of the weight changes described in the preceding section seems to show the existence of membranes which are permeable in some measure to water, at least. In the absence of any other plausible hypothesis it may be assumed that the salts enter or leave the body through these same membranes.

Which of the limiting membranes of the body are thus concerned will be considered later.

Fredericq (1885) states that the blood of salt-water fishes tastes scarcely more salt than that of fresh-water ones. Surely this is hardly an exact quantitative test. He repeats (1891) that it is "not much more salt." Fredericq likewise states (1885) that it has long been known that the muscles and glands of a salt-water fish are not more salt than those of a fresh-water one. I can not find upon whose authority this statement is based. Griffiths (1892) makes the equally unsupported assertion that "the blood of a sole, a haddock, and a weever does not contain more soluble salts than the blood of fresh-water fishes" (p. 140).

Atwater (1891) gives the percentage of chlorine in the flesh of two salt-water species analyzed by him as follows: Black-fish (*Tautoga onitis*) 0.23, mackerel (*Scomber scombrus*) 0.24; mean, 0.235.

Three fresh-water fishes[a] gave the following percentages: Salmon (Penobscot River—spent) 0.18; salmon (landlocked—spent) 0.20; shad (Connecticut River) 0.22; mean, 0.20.

It thus appears from the figures of Atwater that the flesh of the fresh-water fishes analyzed by him had about 15 per cent less chlorine than that of the salt-water ones. In comparing his percentages just quoted with mine it must be remembered that Atwater used the flesh alone while I used the entire fish, including the skeleton. The proportion of chlorides in the latter we should expect to be smaller than in the flesh.

The figures given by Almén (cited by Atwater) show such enormous differences in the amounts of chlorine in different fishes (his maximum figure being nearly 15 times as great as his minimum) that they are certainly to be regarded with suspicion. It may be noted, however, that the average figure for salt-water species is much higher than that for the fresh-water ones (0.122 and 0.076, respectively, provided that we count the salmon and eel among the fresh-water ones).

Katz (1896) gives the mean percentage of chlorine in the dorsal muscles of 2 large eels (apparently from fresh water) analyzed by him as 0.03448; the mean figure for 2 pike was 0.03191; that for 2 haddock ("Schellfisch") was 0.24093. Such results certainly demand confirmation. It may be noted that Almén's figures for the eel and pike were 0.013 and 0.186, respectively.

Church (1903) states that he found 0.2 per cent of "common salt" in a "mackerel in good condition." This would place the percentage of chlorine at about 0.121. Atwater's figure was almost exactly twice as great.

As regards the salinity of the blood, the determinations of Quinton (1904, pp. 439–440) give the mean percentage of chlorine[b] in the blood of 8 species of marine teleosts as 0.651, that for 3 fresh-water species as 0.411. From these figures it would appear (1) that the salinity (at least the proportion of chlorine) of the blood is several times that of the body as a whole, and (2) that the salinity is over 50 per cent greater for salt-water than for fresh-water species. Mosso (1890) likewise states that sea fish have more salt in their blood than fresh-water ones, though he offers no figures in support.

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[a] The shad and the Atlantic salmon are of course anadromous, but the present specimens appear to have been taken in fresh water.

[b] Quinton's original figures are given in terms of NaCl, but I have reduced them to corresponding values in chlorine.

Numerous authors have determined the percentages of "ash" in the flesh of fishes, though none, so far as I know, have had in view a comparison between the fresh and the salt water species.

The average percentage of ash in 7 fresh-water[a] species analyzed by Atwater was 1.30; for 11 salt-water species, 1.41.

From the determinations of Payen and Kostytscheff (cited by Atwater) it may likewise be gathered that the averages for the salt-water fishes are substantially greater than those for the fresh-water ones.

The figures of Balland (1898) and of Milone (cited by Lichtenfeld, 1904) also give average percentages of ash which are considerably greater for salt-water than for fresh-water species. According to Balland, the figure for eels from fresh water is 0.76, that for salt-water specimens being 0.87.

An exhaustive search of the literature of this subject would perhaps reveal figures which would not harmonize with the general trend indicated above. But, so far as I have been able to learn, one important conclusion may be drawn from the records as a whole, despite great inconsistencies—namely, that both the proportion of ash in general, and the proportion of chlorides in particular, are, on the average, greater in salt-water fishes than in fresh-water ones. The ratio between the two can not, of course, be stated with any exactness. For such a ratio to have any value it would be necessary that each of the mean percentages should be based upon a very large number of exact determinations. Leaving out of account the figures of Katz, however, the mean percentage (either of chlorine or of ash) for the salt-water fishes is in every case less than twice that for the fresh-water ones. In most cases it is much less. On the other hand, the ratio between the amount of chlorine found in sea water and that in ordinary fresh water is as several thousand to one. The following table gives the percentages of chlorine found in several of the grades of water used by me in the experiments:

	Parts of chlorine per 100.
New York City (Croton) water	0.0003
Woods Hole (Falmouth) water	.0011
Daggetts Pond (Marthas Vineyard)[b]	.0051
Water giving salinometer reading about 1.001	.0584
Water giving salinometer reading about 1.002	.1252
Local sea water (1.023)	1.8180

It is thus seen that the water of specific gravity 1.002 (equivalent to that of Tashmoo Pond during the present summer) contains a percentage of chlorine not very far different from that of the fishes (*F. diaphanus* and the white perch, experiments 104 and 108) living in it and, indeed, of the same order of magnitude as that of any of the teleosts analyzed by me. That such water can not even be approximately isotonic with the body fluids of these fishes seems evident from the cryoscopic determinations of other investigators.[c] Nevertheless the approximate equality between the percentage of chlorides in this slightly brackish water and in the tissues of teleost fishes is profoundly interesting in view of the great physiological importance to certain species of even such a small proportion of salt in the water. It is interesting to recall in this connection that the "1.001" water did not appear to be quite saline enough to support the life of *F. majalis* indefinitely. (Experiment 31 bis.)

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[a] I have counted the shad and salmon among the fresh-water fishes, the smelt among the salt-water ones.

[b] From which came the white perch used in experiment 110.

[c] The figures obtained by me do not of course indicate the proportions of chlorine in the fluids, but rather those for the body as a whole. It is likewise to be remembered that the osmotic pressure of the body fluids is in part determined by various organic matters in solution and not entirely by salts.

The records of other investigators (to be discussed later) show that the osmotic pressure of the blood of salt-water teleosts is somewhat higher than that of fresh-water ones, though this fact has been almost lost sight of in the zeal to prove that the internal medium is not isotonic with the external and that its osmotic pressure is relatively constant.

It may be objected once more at this point that all this discussion of the relative salt content of fishes inhabiting fresh and salt water, together with the resulting differences in osmotic pressure, is quite irrelevant, since the differences found may depend upon the degree of salinity of the food eaten, and not directly upon the salinity of the water which bathes the body. This objection can only be met by reference to the changes which certain species were found to undergo in the course of a single day, no food being taken. It is theoretically possible, even in these cases, on the one hand that salt water was swallowed and the salts absorbed, on the the other that salts should have left the body by way of excretion. The former possibility I regard as sufficiently met by the analyses of the contents of the alimentary canals (indeed, of the entire viscera) described above. The second possibility is not entirely excluded, though it seems unlikely a priori that the decrease in salinity which occurs in fresh water should be due to a cause quite distinct from that responsible for the increase in salt water.

THE PART PLAYED BY THE GILLS IN OSMOTIC EXCHANGES.

The thin membranes covering the gill filaments are especially adapted to facilitating exchange between the gases contained in the water and those contained in the blood. It would therefore be natural to look here for one path of diffusion for water and salts as well. The greater part of the body surface, on the contrary, is in most teleosts covered with a layer of scales, which would seem to present a barrier to any great amount of osmotic exchange between the tissues and the water which bathes the body. The lining of the alimentary canal is of course readily permeable to fluids and to various substances in solution, but this, it is needless to say, is not freely exposed to the surrounding medium. Water or salts, in order to be thus absorbed, must either be swallowed or force their way in through the anus. Such an entry of fluids would not, however, be consistent with the decrease in the weight of a fish which frequently follows its transfer to a stronger salt solution. Yet it seems to be proved by some of the foregoing experiments that salts are in some way taken into the body after such a transfer.

The part played by the gills in this process I have demonstrated by a series of comparatively simple experiments. A piece of apparatus was devised, by the aid of which it was possible to pass salt water through the gills, while the remainder of the body was bathed in fresh water, or vice versa. A wooden frame was made (fig. 1), consisting of a rectangular piece of planed board, near one end of which a shelf was fastened, containing an aperture large enough to admit the head of a fish. The body of the animal was loosely bandaged, the cloth being tacked to the vertical piece of wood in order to restrain movement (fig. 2). A piece of sheet rubber was then perforated and drawn over the head in such a way that it fitted snugly around the body, just behind the gill covers. The margin of the rubber being tacked to the wooden frame, a nearly water-tight partition resulted, which served to bound off the head from the trunk region. The frame, bearing the fish, was now immersed in a rectangular jar of water, the head being uppermost, except in two specified cases. Fresh (or salt) water was supplied to the jar through a rubber tube, while another tube carried salt (or fresh) water into the mouth, allowing it to pass out through the gills. A second bandage held the head in position, while the pectoral fins were securely bound to staples.

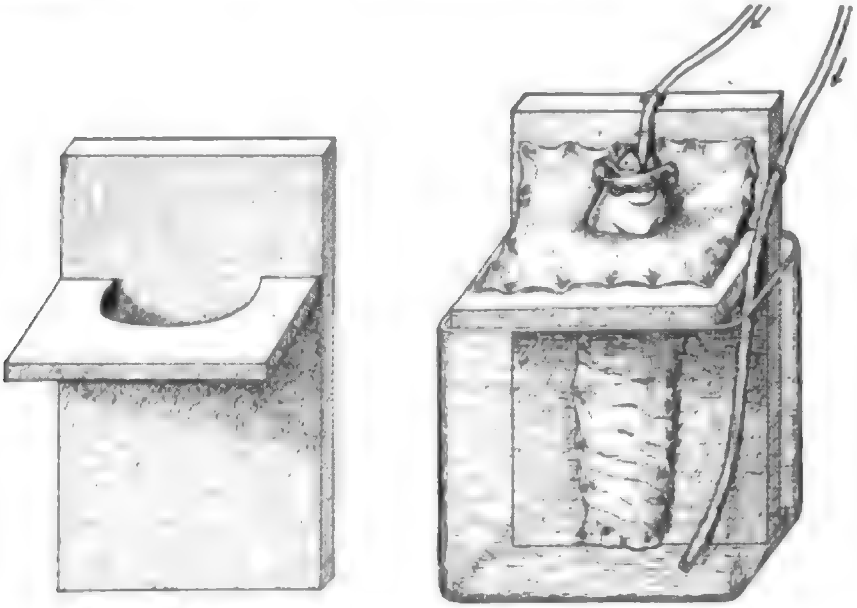

FIG. 1.

FIG. 2

Device used in experiment to determine the part played by the gills in osmotic exchanges.

The following six experiments were made with the carp. The fishes were weighed before and after the treatment, the same precautions being taken as have already been described for earlier experiments.

Experiment 113.

New York, May, 1905.[a] One carp (fed 24 hours previously), weight 86.1 grams. Salt water (1.014) through gills, fresh on body. After 5 hours alive, though feeble; weight 80.9 grams. The fish thus lost 6 per cent.

Experiment 114.

One carp (fed 24 hours previously), weight 63.6 grams. Fresh water through gills, salt on body. After 5¼ hours fish well; weight 63.8 grams. Weight thus practically unchanged.

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[a] Date and place the same for all of this series.

Experiment 115.

One carp (unfed for 22 days), weight 353.5 grams. Salt water through gills, fresh on body. After 15 hours fish dead; weight 338.7 grams. Loss of about 4 per cent.

Experiment 116.

One carp (unfed for 22 days), weight 34.2 grams. Fresh water through gills, salt on body. After 14½ hours fish in good health; weight 34.5 grams. Weight practically unchanged.

Experiment 117.

One carp (same specimen as used in 116), weight 33.6 grams. Salt water through gills, fresh on body. After 16½ hours fish dead; weight 31.1 grams. Loss of 7.4 per cent.

Experiment 118.

One carp (fed preceding day), weight 476.7 grams. Fresh water through gills, salt on body. After 7 hours weight 476.8 grams. Weight practically unchanged.

It will be noted that a considerable loss of weight occurred in all of those cases in which salt water passed through the gills and fresh water over the body, while the weight remained practically stationary in those cases in which the conditions were reversed. Under such harsh treatment the death of any of these fishes would not have occasioned surprise. As a matter of fact, however, the three whose gills were bathed by fresh water all remained well till the end of the experiments, while of those whose gills were bathed by salt water, two died and one sickened.

The part played by the gills in the death of fresh-water fishes in salt water has been discussed by Bert (1871, see p. 101). Bert states that "a tench suspended in a vessel full of sea water, the head remaining outside, lives for a long time, if care be taken to bathe the gills with fresh water." No weight determinations are recorded. In the case of (practically) naked-skinned fishes, such as the eel and loach, Bert held that the general integument made possible the extraction of water from the tissues when the fishes were transferred to salt water.

Two scaleless species were tested by me according to the method described above. The results were here far less satisfactory than those for the carp.

Experiment 119.

Sea raven (unfed for 8 days), weight 334.8 grams. Salt water through gills, fresh on body. After 6 hours fish dead (for some time); weight 332 grams. Loss of about 0.8 per cent.

Experiment 120.

Sea raven (unfed for 7 days), weight 456.3 grams. Fresh water through gills, salt on body. After 19½ hours fish dead (how long?); weight 462.5 grams. Gain of 1.4 per cent.

The loss in the former experiment is scarcely significant, being perhaps fully accounted for by the removal of mucus in drying the fish for weighing. The gain in the second experiment is what would be expected on hypothesis, though the fact that the fish had been dead for an indefinite period lessens greatly the force of this evidence.

Experiment 121.

Catfish (*Ameiurus nebulosus*) (unfed 17 days), weight 121.6 grams. Salt water through gills, fresh on body. After 22 hours fish dead; weight 115.1 grams. Loss of 5.3 per cent.

Experiment 122.

Catfish (unfed 17 days), weight 159.8 grams. Fresh water through gills, salt on body. After 23½ hours fish dead; weight 167.3 grams. Gain of 4.7 per cent.

This gain is probably due to the absorption of water after death, as discussed earlier. It may be due, however, to the animal's having swallowed water.

So far none of these experiments have given results actually contradictory to my view regarding the part played by the gills. The following pair of experiments, however, are not in harmony with the others:

Experiment 123.

Catfish (fed 24 hours previously), weight 156.9 grams. Salt water through gills, fresh on body (fish inverted). After 14 hours fish still stirring; after 22 hours fish dead; weight 157.1 grams. Weight practically unchanged.

Experiment 124.

Catfish (fed 24 hours previously), weight 227 grams. Fresh water through gills, salt on body (fish inverted). After 14 hours fish dead; weight 220.5 grams. Loss of nearly 3 per cent.

Occasional inconsistencies in the results such as these might naturally be expected under the conditions of experiment. The swallowing of water at any time would result in an increase in weight, the discharge of feces in a decrease. In this connection it will be noted that the fishes used in the last two experiments had been fed 24 hours before.

It is possible, however, that naked-skinned fishes react somewhat differently from scaly ones, as was supposed by Bert. Experiments with such fishes should of course be repeated.

If water or salts be taken in or passed out of the body through the membranes of the gills, it seems to follow that the blood must be the medium of such exchanges.[a] Such differences in salinity as were indicated for the fishes used in the analyses above could not, however, have depended entirely upon differences in the salinity of the blood, since the volume of the latter is not sufficient to account for them. Indirectly, then, some or all of the other tissues of the body must have been affected. Where, in the preceding pages, I have referred to the "body fluids," I have meant to include, not merely blood and lymph, but the liquid content of the tissues in general.

It has been assumed by Fredericq (1885) that in certain invertebrates the osmotic equilibrium which is maintained between the body fluids and the surrounding water is due to the permeability of the gills. Concerning fishes, however, he declares "the gills, so permeable to the gaseous exchanges of respiration, seem on the contrary to constitute an almost impassable barrier to the salts dissolved in sea water."

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[a] Of course living fishes only are here intended.

HISTORICAL REVIEW.

The work of Bert (1871, 1873, 1883) has been more than once referred to in the preceding pages. Bert's explanation of the "mechanism of death" in the case of the fishes studied by him deserves some attention. This writer explained the fatal effects of salt water upon fresh-water fishes by assuming an osmotic action upon the gills. The capillaries of the latter became contracted, and the blood cells, distorted by the action of the salt water, soon plugged them up and thus arrested the branchial circulation. The immediate cause of death was thus believed to be asphyxiation. In the case of scaly fishes, this occurred, he believed, before any considerable amount of water was abstracted from the body osmotically and before the blood in the larger vessels was altered to any appreciable extent. With naked-skinned fishes, on the other hand, osmotic action occurred throughout the entire surface of the body, and the consequent loss of water from the tissues was one factor in causing death. Bert is not entirely consistent in his views, however, for he likewise tells us that "death is definitely due to the chlorides," and "inversely [referring to the death of salt-water fishes in fresh water] it is the suppression of the sodium chloride which causes death." This salt he found could not be replaced by any other substance which he tried. Thus, the importance of chemical factors is recognized by him, though he denies that the salts in sea water act as poisons to fresh-water fishes. The differences in the reactions of different species of fishes are "due to differences in the chemical composition of the branchial epithelium and in the exosmotic properties of this epithelium."

Mosso (1890) also held (for sharks, at least) that the death of the fishes, when placed in fresh water, was the result of asphyxiation due to the blocking of the gill capillaries by disintegrated blood cells. In such a fish he found it impossible to force salt solution through the branchial capillaries, though this could be done readily in the normal animal. Mosso likewise records differences in the resistance of the blood cells of various fishes to the hæmolytic action of dilute salt solutions, implying that such differences may be accountable for the relative power of these animals to withstand changes in the density of the medium. In the case of certain migratory fishes, which inhabit either medium (*Acipenser*, *Salmo*, *Anguilla*, *Petromyzon*) he found the corpuscles to be particularly resistant, being able to remain many hours in a salt solution as dilute as 0.3 to 0.4 per cent without giving up their hæmoglobin. Sea fishes as a rule he found to have less resistant corpuscles than fresh-water ones. Other investigators (Hamburger, 1887; Bottazzi and Ducceschi, 1896, and Rodier, 1899) have performed similar experiments upon the erythrocytes of various fishes, likewise finding great differences in their resisting powers, though not in all respects agreeing with the determinations of Mosso.

Of course any such effect of the surrounding medium upon the cells of the blood presupposes some way by which it may reach them. Bert believed that in fishes (at least the scaly ones) death occurred before any considerable portion of the blood was affected, the osmotic effects being restricted to the gills.

In any discussion of the effects of changes in water density upon aquatic organisms, the osmotic factor must play a leading part. Much light has in recent years been thrown upon the osmotic relations maintained between the "internal and external media." The now rather celebrated utterance of Claude Bernard (1865, p. 110) is perhaps worth repeating here; I do not recall its having been quoted in an English work:

> In all living beings the internal medium, which is a true *product of the organism*, preserves the necessary relations of exchange and of equilibrium with the external cosmic medium, but in proportion as the organism becomes more perfect, the organic medium specializes and isolates itself, in a certain manner, more and more from the surrounding medium.

The Belgian physiologist, Fredericq, was one of the first to investigate the osmotic relations between the body fluids of marine organisms and the medium in which they live. By the method of dialysis, and by determinations of the salinity of the body fluids, he found that in various marine invertebrates these fluids were nearly or quite isotonic with the sea water. He likewise showed that changes in the salinity of the water resulted in corresponding changes in the body fluids. As regards fishes (both elasmobranchs and teleosts) Fredericq maintained that the osmotic pressure was considerably less (about one-half) than that of the external medium.

Bottazzi and his colleagues, working at Naples, employed the cryoscopic method, using Beckmann's apparatus. By this method the freezing point of a solution is determined with precision, and from this the osmotic pressure, according to well-known physical principles. Bottazzi arrived at the same conclusion as Fredericq, relative to the osmotic pressures of the body fluids of marine invertebrates. The reduction in the freezing point (Δ) due to osmotically active substances in solution was found to be nearly constant, ranging from −2.195° C. to −2.36° C. The mean of all his determinations was −2.29° C., which is the same figure as his mean determination for the local sea water.

Practically identical results were obtained for elasmobranch fishes, the mean osmotic pressure for the blood of three species being expressed by: $\Delta = -2.356$ C. The difference between these results and those of Fredericq is explained by the fact that the latter inferred a lower osmotic pressure for the blood of elasmobranchs from its lower salt content. The blood is rendered isotonic with sea water, however, by the presence of an unusually large proportion of urea. This correction has been accepted by Fredericq himself.

For the blood of two species of marine teleosts four determinations by Bottazzi yield the mean figure: $\Delta = -1.036$. The blood of these fishes thus appears to have an osmotic pressure about half that of the water which they inhabit.

Rodier, Quinton, and Garrey have also determined that the vascular fluids of various marine invertebrates are practically isotonic with the water which they inhabit. Rodier and Garrey, employing the cryoscopic method, have likewise confirmed the conclusions of Bottazzi regarding the elasmobranchs, while Rodier, Fredericq, and Garrey have by this method obtained confirmatory (though not identical) results for teleosts.

The mean value of Δ for two elasmobranchs tested by Garrey at Woods Hole is −1.92°. The mean value for five teleosts is −0.872°, the figures ranging from −0.80° (minimum for conger eel) to −0.96° (maximum for swordfish). The value of Δ for the sea water of the neighborhood was about −1.82°.

The testimony of a number of investigators seems, then, to be in full accord upon certain main points, which may be provisionally accepted as proved. Fredericq (1904) has classified the three sorts of aquatic organisms, relative to osmotic conditions, as follows: (1) Molecular concentration and salt content both approximately the same for the [vascular fluids of] animal as for the surrounding water (marine invertebrates); (2) molecular concentration the same, but proportion of salts less—the deficiency being compensated for by organic matters in solution—(elasmobranchs); (3) both molecular concentration and salt content very different from those of external water (teleosts, both marine and fresh water; fresh-water invertebrates).

It is with the third class that we are especially concerned in the present paper. The molecular concentration (hence the osmotic pressure) and the salt content are both very different from those of the surrounding medium. It seems never to have been fully appreciated that there is even here a certain correlation between the inner and the outer fluids, both as regards osmotic pressure and salt content. But reference to the various cryoscopic determinations shows that not all teleosts have blood of the same osmotic pressure. Rodier found the latter to range between $\Delta = -0.62^\circ$ and $\Delta = -0.80^\circ$ in *Lophius* alone. What is more significant is that the blood of fresh-water fishes has been found to possess, on the average, a considerably lower osmotic pressure than that of marine fishes. The mean figure given by Fredericq (1904) for two marine teleosts is $\Delta = -0.80^\circ$, that for three fresh-water species is about -0.53°. Of course in the case of these fresh-water fishes, the osmotic pressure of the blood, though lower than that of marine fishes, is nevertheless very much higher than that of the fresh water in which they live. Satisfactory determinations of both fresh and salt water individuals in the case of species inhabiting both have not, so far as I know, been made. As noted above (p. 96), Balland found that the flesh of eels from salt water contained a considerably greater percentage of ash than those from fresh water. Similar differences in chlorine content were obtained by myself in the case of several species, and in general it has been shown that the percentage of salts is greater in salt-water fishes than in fresh-water ones. It must be borne in mind, however, that these determinations of salts were made for the flesh of the fishes, while those of osmotic pressure were made upon the blood. So far as I know the only recorded comparison of the salt content of the blood of fresh and salt water fishes was made by Quinton (p. 95). A considerably higher percentage was indicated for the marine forms. If the figures of Quinton are correct, it is likewise to be noted that the percentage of chlorides in the blood is several times as great as in the flesh. Of course the osmotic pressure of neither is entirely dependent upon the percentage of salts, but may depend upon organic matters in solution, as was found in the case of elasmobranch blood. Fredericq (1904) has attempted to determine the osmotic pressure of the solutions contained in the various tissues of fishes and invertebrates, partly by extracting the soluble ingredients by boiling, partly by noting the changes of weight in strips of tissue suspended in solutions of varying concentration. Reasons for doubting the value of the latter method have already been given (p. 84).

Where a correlation is found to exist between the osmotic pressure of the body fluids of an animal and that of the surrounding water, the question arises, How is this correlation maintained? For various invertebrates, it seems to have been generally held (Fredericq, Atwater[a], Quinton, Garrey) that the bounding membranes, or some of them, are permeable both to water and salts. Botazzi and Enriques, on the other hand, from experiments upon the excised gut of *Aplysia*, conclude that, in a normal condition, this and presumably the other limiting surfaces of the body are only semipermeable. This condition, of course, would be sufficient to insure an osmotic equilibrium between the organism and its environment. Equivalence in the proportions of the various saline ingredients is maintained, according to these writers, on the one hand through the process of (nutritive) absorption, occurring chiefly in the ducts of the digestive gland; on the other through the organs of excretion.

For the elasmobranchs, a permeability to water seems to follow from the facts above stated. An unlimited permeability to salts must, on the other hand, be excluded, if, as seems proved, the salt content of the blood is so far below that of sea water. Whether the (gill?) membranes are in any degree permeable to salts has not been determined experimentally.

In the case of teleosts, it does not seem to have been generally appreciated that there is a certain correlation between the inner and outer fluids, both as regards osmotic pressure and salt content; and certain authors have been free to state that the membranes of teleost fishes form an effective barrier against osmotic changes. Fredericq (as quoted above, p. 100) makes this assertion broadly; while Garrey says of *Fundulus heteroclitus:* "The integument and gills are therefore impermeable." Garrey is cautious enough, however, not to postulate an absolute impermeability either for *Fundulus* or for teleosts in general.

SUMMARY AND CONCLUSIONS.

The more important results of the foregoing experiments may be very briefly summarized as follows:

(1) Certain brackish and salt-water fishes were unable to survive even a gradual transfer to pure fresh water, though enduring an abrupt transfer to water of a very low degree of salinity. Thus fresh water, as such, proved fatal to these fishes, the degree of abruptness of the change being of secondary importance.

(2) Considerable changes of weight were found to result, in many cases, from changes in the salinity (hence the osmotic pressure) of the surrounding medium.

(3) Considerable changes in the salt (chlorine) content of the body were likewise found to result, in many cases, from changes in the salinity of the water.

(4) Careful control experiments excluded the possibility that the water or salts entered or passed from the body through the alimentary canal, leaving as the only probable alternative an osmotic exchange through one or more of the limiting membranes.

(5) In certain fishes, at least, it was found that the membranes chiefly concerned in such exchanges were those of the gills.

Accordingly, we can not conclude from the absence of osmotic equilibrium between the fish and its environment that no osmotic interchanges normally occur. On the contrary, abundant experiments seem to prove that both water and salts may under certain conditions be transmitted in either direction without any harm resulting to the fish. These conditions seem impossible to state in advance for a given case. In general we may say that:

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[a] For oysters, op. cit., p. 814.

(1) Measurable changes in weight result only from considerable changes in the density of the surrounding water, but—

(2) Not all such changes of density suffice to produce changes of weight, even when the fish is transferred to a medium which is known to be strongly hypertonic or hypotonic to its own body fluids.

(3) Changes in the salinity of the water may or may not result in changes in the salt content of the body.

(4) Changes in the body salt content may or may not be accompanied by changes in weight.

(5) Neither the changes in weight nor in salt content are at all proportional to the changes in the density of the external medium.

It would appear that there is normally a tendency on the part of the fish to resist osmotic changes and to maintain the fluids of the body at a definite degree of concentration. Under various conditions, however, this resistance is overcome and a certain degree of permeability is established. This is generally a differential permeability, resulting in osmosis and consequent changes of weight. In such cases, however, the membranes are not strictly semipermeable, but transmit salts in some measure. Indeed, it would seem that at times the permeability is indiscriminate, in which case the salts may diffuse freely, but no changes in weight occur. These various changes continue until a new level of stability is established, after which the normal resisting power of the fish reasserts itself and no further alteration occurs so long as the medium is constant. Complete osmotic equilibrium between the fish and the water is probably never attained except in waters having roughly a medium degree of salinity. The osmotic pressure of the "internal medium" fluctuates within a much narrower range than that of the "external medium."

The foregoing conclusions are intended to apply only to normal fishes. It seems certain that the enfeeblement of the fish may result in an increased permeability of the membranes, which in turn would doubtless result in a further enfeeblement of the fish. The death of those fishes which can not withstand transfer to a medium very different from that to which they are accustomed is thus probably in part a cause and in part an effect of these changes. Death is accompanied (perhaps in some cases caused) by a giving way in the power to resist an abnormal degree of osmotic exchange. The body becomes water-soaked (if in fresh water), or dehydrated (if in salt). The difference between the more hardy and the more delicate species in this regard seems to lie partly in the resisting power of the limiting membranes (chiefly those of the gills); partly, also, in internal differences, such as composition of blood, etc., which determine whether a given influx or efflux of water or salts shall prove fatal.

The actual cause of death following a change in the salinity of the water seems to differ in different cases. With those fishes which succumb rapidly with but a slight change of weight (e. g., scup, experiments 69–71), it is unlikely that any appreciable alteration occurs in the tissues at large. Such changes are probably confined to the blood, perhaps, as Bert held, to that in the gill capillaries. In those cases, on the contrary, where the fatal effects are not manifested for some days, it seems likely that the manner of death is different. In the case of *F. heteroclitus* it was found in most instances that the endosmotic flow of water had ceased, and that a decrease in weight had ensued within one or two days after transfer to fresh water. On the other hand, it will be remembered that fishes of this species commonly did not die for a considerable number of days, while many survived for a week and some even for several weeks. Again, it will be recalled that the fatal effects of fresh water upon this and some other species were nullified by the admixture of a very small percentage of salt water. Analyses showed that in this latter case there was little or no decrease in the salt content of the body. A rough approximation was pointed out (p. 96) between the percentage of salts in this faintly saline water and that in the fishes themselves. All of these facts point to the conclusion that one factor in the death of salt-water fishes in fresh water is the extraction from their tissues of an amount of salts sufficient to reduce the percentage below a certain necessary minimum.

If the question be asked, Why are not fresh-water fishes thus affected in their own medium? it is replied that their membranes have been adapted to resisting such an extraction of salts. It is perhaps also true that the irreducible minimum of salts in these species is lower than in the case of salt-water ones. In any case the percentage actually present is, on the average, less.

Whether or not salt water ever has a toxic effect, in the narrower sense, upon fresh-water fishes can not be stated definitely. Bert denied that such was the case, but, as already stated, he is not entirely consistent in his position. In view of the fatal effects upon salt-water fishes of some of the individual components of sea salt, when taken separately (Loeb, 1900; Siedlecki, 1903), it seems quite possible that sea water itself may act as a poison to fresh-water organisms, independently of any osmotic effects. Indeed, both of these writers have shown that it is the chemical nature of the solutions used rather than their osmotic pressures which determines, in many cases, whether they shall prove fatal.

SUPPLEMENTARY NOTE.

It gives me great pleasure to find in a paper by Prof. C. W. Greene on the physiology of the chinook salmon, just published, that certain of the results obtained by him lend strong support to the views upheld in the preceding pages. Greene finds a very considerable difference between the osmotic pressure of blood from salmon taken in sea water and of that from fishes taken at the spawning grounds far upstream. The mean values for Δ given by Greene are -0.762 and -0.628°, respectively, showing a decrease of 17.6 per cent in the fresh-water individuals. Greene is not convinced, however, that osmotic changes have been responsible for this decrease, but is of the opinion that "the absence of food and the important metabolisms occurring during the eight to twelve weeks' sojourn in fresh water are to be considered in this connection, and possibly are sufficient to account for the change" (p. 455).

Another of Greene's results is of great interest to me, namely, that he found but a slight reduction (3.3 per cent) in the osmotic pressure of the blood of salmon taken in faintly saline water near the (Sacramento) river's mouth. Greene's conclusion appears to be that the slight extent of this reduction was owing to the short time which had elapsed since the fishes had left the sea. Unfortunately the length of this interval is not stated. According to Rutter's account, the first steps of the passage into the Sacramento River are rather gradual, the fish falling back somewhat with each ebb tide. My own experiments show that with certain fishes, at least, a single day's sojourn in fresh water is sufficient to effect a considerable reduction in the salt content of the body. On the other hand, even a very slight degree of salinity was sufficient to prevent this change. In the absence of further data I suggest the same explanation for the results obtained by Greene with the brackish-water salmon.

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OPISTHOBRANCHIATE MOLLUSCA FROM MONTEREY BAY, CALIFORNIA, AND VICINITY.

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This paper does not purport to be a complete list of the Doridoidea found in Monterey Bay and vicinity, but probably includes all of the commoner forms there represented. It is based upon collections made at various intervals since 1892, mostly in the immediate vicinity of Pacific Grove, Cal., and much of the manuscript has been for several years in practically the form here presented. It was not deemed desirable, however, to publish the descriptions of some of the rarer forms until the acquisition of further specimens had made possible more extended morphological study. Several species which now are represented by but a single individual in the collection are withheld for the present.

This study was conducted at the Hopkins Seaside Laboratory,[a] which is situated on the southernmost shore of Monterey Bay, about 120 miles south of San Francisco. The entrance to the bay is about 20 miles broad, and its northern and eastern shores present an almost continuous sandy beach, broken at long intervals by short rocky stretches; but on the south, from Monterey onward, the shore line is much more diversified, granitic cliffs rising to 40 or 50 feet above the sea and offering every variety of rocky coves and sheltered sand beaches, with a wealth of littoral animal and plant life. Point Pinos forms the southern headland of the bay, but the general character of the coast continues the same for several miles southward. Beyond Cypress Point opens another and much smaller bay, Carmelo Bay, at the mouth of the Carmel River, with the rugged and precipitous Point Lobos at its southern boundary. The most of the forms herein described were collected along the southern shore of Monterey Bay and the neighboring coast line as far south as Point Lobos and are mainly from the tidal zone, though some dredging has been done also.

The general systematic arrangement of the group here followed is modified from that of Prof. R. Bergh as given in his System der Nudibranchiaten Gasteropoden (Wiesbaden, 1892). For the convenience of other students of the group on the Pacific coast, the characters of all the families and subfamilies have been given, whether representatives of them have been taken in Monterey Bay or not. In several cases the generic characters given by Bergh have been slightly modified in unimportant points to admit forms belonging unmistakably to the genus.

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[a] My sincerest thanks are due to the directors of the Hopkins Seaside Laboratory, Professors Jenkins and Gilbert, for the facilities afforded me by that institution and for their unfailing kindly interest and encouragement in my work. The generous cooperation of Mr. Timothy Hopkins, of San Francisco, made possible the illustration of many of the species represented in this paper. I am indebted to the Smithsonian Institution for the assignment of a table in the Naples Zoological Station during the winter of 1902-3, where I had the valuable opportunity of studying and comparing many of the Mediterranean forms with those of the California coast. My grateful acknowledgments are due likewise to Professor Dohrn and his able staff.

For the identification of even the genera to which many of the nudibranchiate mollusca belong, it is necessary to make a full and careful dissection. This has been done in each case, but a complete morphological description of the forms discussed in the present paper has not been attempted, simply an abridged account of the anatomy sufficient for their ready identification being here contemplated. It has been my especial endeavor to secure adequate colored drawings of all species not elsewhere so illustrated. Unfortunately, with the exception of Alder and Hancock, Trinchese, Vayssière, and a few others, not many authors have published such illustrations. The lack is the more deplorable on account of the impossibility of preserving the beautiful colors, or even the natural form, in the museum specimens.

The following tabulation will indicate the general systematic relationship of the forms discussed in the present paper. With the exception of the early and fragmentary papers of Gould, Cooper, and Stearns, and several more thorough ones of Bergh, the California opisthobranchiate Mollusca are practically unknown. This fact accounts for the large proportion of new species found by me, which have been described in a brief preliminary paper published in the Proceedings of the Biological Society of Washington (vol. xviii, Feb. 2, 1905), under the title "A Preliminary Account of the Dorididæ of Monterey Bay, California." The types of these are deposited in the United States National Museum, and cotypes will be placed in the zoological museum of Leland Stanford Junior University and the museum of the Philadelphia Academy of Sciences; also in the author's collection.

Order OPISTHOBRANCHIATA.
Suborder NUDIBRANCHIATA.
Section DORIDOIDEA.
Family A. DORIDIDÆ.
Subfamily I. Bathydoridinæ.
Subfamily II. Hexabranchinæ.
Subfamily III. Archidoridinæ.
1. Archidoris montereyensis (Cooper).
2. Anisodoris nobilis (MacFarland).
Subfamily IV. Discodoridinæ.
3. Discodoris heathi MacFarland.
4. Rostanga pulchra MacFarland.
Subfamily V. Diaululinæ.
5. Diaulula sandiegensis (Cooper).
6. Aldisa sanguinea (Cooper).
Subfamily VI. Cadlininæ.
7. Cadlina marginata MacFarland.
8. Cadlina flavomaculata MacFarland.
Subfamily VII. Kentrodoridinæ.
Subfamily VIII. Platydoridinæ.
Subfamily IX. Chromodoridinæ.
9. Chromodoris porteræ Cockerell.
Subfamily X. Miamirinæ.

Order OPISTHOBRANCHIATA—Continued.
  Suborder NUDIBRANCHIATA—Continued.
    Section DORIDOIDEA—Continued.
      Family B. DORIOPSIDIDÆ.
          10. Doriopsis fulva MacFarland.
      Family C. PHYLLIDIIDÆ.
      Family D. POLYCERIDÆ.
        Subfamily XI. Polycerinæ.
          11. Aegires albopunctatus MacFarland.
          12. Laila cockerelli MacFarland.
          13. Triopha carpenteri (Stearns).
          14. Triopha maculata MacFarland.
          15. Triopha grandis MacFarland.
          16. Polycera atra MacFarland.
        Subfamily XII. Goniodoridinæ.
          17. Acanthodoris hudsoni MacFarland.
          18. Acanthodoris brunnea MacFarland.
          19. Ancula pacifica MacFarland.
          20. Hopkinsia rosacea MacFarland.
      Family E. CORAMBIDÆ.
      Family F. DORIDOXIDÆ.

OPISTHOBRANCHIATA.

NUDIBRANCHIATA.

DORIDOIDEA.

Genital conduit triaulic, liver completely inclosed in the visceral mass, female duct bifurcated. Anal aperture postero-median, upon the dorsum, surrounded by the branchial rosette, or rarely between the peri-notæum and the foot.

Family A. DORIDIDÆ.

Branchial plumes in an arc or circle usually joined together at their bases, usually retractile into a common cavity. Rhinophores always with perfoliate clavus. Pharyngeal bulb never suctorial.

Subfamily I. BATHYDORIDINÆ.

Body (large) almost semiglobular, soft, pallial margin scarcely any; tentacles rather large, somewhat flattened, acuminate; branchial plumes many (6), entirely separate, nonretractile; the foot wide. Pharyngeal bulb very large, similar to that of the Tritoniadæ; labial armature none; mandibles large, flattened, masticatory margin smooth. Median tooth of radula somewhat compressed; lateral teeth numerous, hooked, edentulate. Hermaphrodite gland separate from the liver; penis unarmed.

Subfamily II. HEXABRANCHINÆ.

Body (large) soft, flattened, elongate oval; dorsum smooth; pallial margin wide, undulating, its margin thin, undulating; tentacles large, foliaceous, their margins fluted; branchiæ of many (6–8) separate arborescent plumes, retractile into separate cavities; the foot wide. Labial armature very strong, on each side a thick lamella made up of very minute hooks. Rhachis of radula naked; lateral teeth numerous, hooked, edentulate. Penis very long, unarmed.

Subfamily III. ARCHIDORIDINÆ.

Body not hard, somewhat depressed, the dorsum tuberculate or granulate, pallial margin not narrow; tentacles small; branchial plumes almost always tripinnate or quadripinnate; the foot wide. Labial armature none. Rhachis of radula naked; pleuræ multidentate, teeth hooked. Penis usually unarmed.

Genus 1. ARCHIDORIS Bergh.

Doris, auct.

Archidoris Bergh, Malacologische Untersuchungen (Semper, Reisen im Archipel der Philippinen, II, Bd. III), H. XIV, 1878: p. 616, Supplement-Heft 1, 1880, p. 33; H. XVIII, 1892, p. 1092. Nudibranchiate Gasteropod Mollusca of the North Pacific Ocean, I. Proc. Acad. Nat. Sci. Phila., 1879, p. 106. Report on the Nudibranchiata, Challenger Reports, Zoology, X, 1884, p. 84. System der Nudibranchiaten Gasteropoden, p. 100, 1892. Die Opisthobranchien (Albatross Expedition), Bull. Mus. Comp. Zool., XXV, 1894, 10, p. 157.

Body not hard, subdepressed, notæum granular or tubercular; tentacles short, thick, with external longitudinal sulcus; branchial plumes not numerous, 3–4 pinnate; the foot wide, its anterior margin superficially sulcate. Labial armature none. Rhachis of radula naked, pleuræ multidentate, teeth hooked. Penis unarmed. Vagina unarmed.

1. **Archidoris montereyensis** (Cooper).

[Pl. XXIII, fig. 4; pl. XVIII, figs. 1–5.]

Doris montereyensis Cooper[a], Proc. Cal. Ac. Sci., II, 1862, p. 204; III, 1863, p. 158.

Archidoris montereyensis, Bergh, Mal. Unters., H. XIV, 1878, p. 624. Nudibr. Moll. North Pac. Ocean, Proc. Ac. Nat. Sci. Phila., 1879, p. 107. Syst. der Nudibr. Gast., p. 100, 1892.—MacFarland, Preliminary Account of the Dorididæ of Monterey Bay. Proc. Biol. Soc. Washington, XVIII, February 2, 1905, p. 37.

Body elongate, elliptical, but slightly depressed, the ends nearly equally rounded, dorsum somewhat arched. Dorsum not hard, everywhere closely set with low conical tubercules, in alcoholic specimens somewhat rounded. The largest of these are about 1 mm. in diameter and between them are smaller ones of varying size. Mantle edge thick, extending everywhere beyond the foot except over the tip of the tail when the animal is crawling. General ground color (pl. XXIII, fig. 4) light yellow, having a dusty appearance, due to extremely minute brown, greenish brown, or black dots thickly sprinkled over the dorsum everywhere. Larger patches of the same color are scattered over the dorsum, principally over the median portion, upon as well as between the tubercules, and more sparingly upon the branchial plumes. In alcohol the yellow color is lost, but the dark blotches turn to a dark blue shade and last for some time.

Length up to 50 mm., width 25 mm., height 12 mm.

Foot smooth, elongate, elliptical, light yellow, the anterior margin bilabiate, the upper lip much thicker and wider than the lower, no median notch.

Head inconspicuous, mouth small, a vertical slit, the sides continued into the short, blunt, fold-like tentacles which are auriculate with a clearly marked external groove (pl. XVIII, fig. 5). Rhinophores stout, retractile into conspicuous sheaths, the margins of which bear irregular tubercules similar to those of the general dorsal surface. Stalk conical, the clavus slightly dilated, conical, perfoliate, with 24–30 leaves on each side.

Branchial plumes 7, large, spreading, 3–4 pinnate, yellowish, sprinkled with minute brown or black spots giving them a dusty appearance, occasionally with larger patches of the same color. Deeply retractile within a prominent sheath with tuberculate margin. The plumes are arranged in a U-shaped arc around the anal papilla, which is truncately conical and often tipped with the brown or black color of the spots of the dorsum. Renal pore near the base of the anal papilla and slightly in advance on the right side.

Blood glands small, thin, the anterior one rudimentary, the posterior one behind and in contact with the central nervous system, narrow, ribbon-like, with lobulate margins, about 2 mm. long by 0.5 mm. wide.

Pharyngeal bulb strong, conical, its length about 5 mm.; breadth and height, 4 mm.; the radula sheath projecting behind and below for about 2 mm. as a rounded process. Lip disk rounded, covered with a thick, colorless cuticle.

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[a] The very fragmentary description of Cooper is as follows. "Pale yellowish, with scattered black spots (or entirely brown?); mantle rough tuberculate, or nearly smooth, dorsal tentacles knob-shaped, branchial rays bipinnate, short, in eight divisions, forming a crown-shaped expansion on the posterior third of the dorsum. Foot expanded into a broad, thin margin as wide as the mantle. Length, 3 inches; breadth, 1 inch; height, three-fourths inch; form, elongated oval. Dredged in 6 to 10 fathoms in Monterey Bay, adhering to fragments of sandstone; only 2 obtained in September." The specimens studied by Bergh were taken at Sitka, Alaska, and were sent to him in a dried condition. From a study of this material he assigns *D. montereyensis* to his genus *Archidoris* and gives general measurements of the body (shrunken) and the characteristics of the radula. Further than this no study of the species has been made.

Radula colorless, broad and short, about 4 mm. long by 3.5 mm. in width, deeply grooved, the teeth in 33 rows, the last 3 immature. Rhachis very narrow, naked. Pleuræ multidentate with 42–49 strongly hooked, compressed teeth. The outer face of the pleural teeth convex, the inner concave, the shaft bearing a large triangular, wing-like expansion on its inner margin, its upper edge thickened, the inner thin. Numerous fine, ridge-like striations diverge from the inner margin of the shaft and pass out into the wing throughout its whole extent, being especially prominent in the lower half (pl. xviii, fig. 3). Teeth increasing in size gradually from within outward (pl. xviii, fig. 2), the outermost ones decreasing rather rapidly, the general shape being retained (pl. xviii, fig. 1). Length of shaft of innermost teeth 0.114 mm.; length of hook (perpendicular to longest axis of shaft) 0.054 mm. Length of shaft of largest teeth of middle portion of row, about 0.240 mm.; length of hook of same, 0.150 mm.

Salivary glands long, whitish, ribbon-like, about 2 mm. in diameter, in length 10–12 mm., extending straight backward to the cardiac (posterior) end of the stomach. Stomach in antero-median cleft of the liver, large, saccular, its cardiac end below and posterior, its pyloric end on left anterior side of the visceral mass, the intestine curving upward and to the right along the upper anterior border of the stomach, thence backward in a deep groove in the dorsal surface of the liver to the anus. It is a slender, thin-walled tube about 1 mm. in average diameter and 25 mm. long.

Liver covered everywhere by the hermaphrodite gland, tapering posteriorly and rounded, in front divided into two large lateral lobes by a broad median cleft occupied by the stomach. The left lobe is rounded, the right with anterior and lateral flattened areas caused by pressure of the anterior genital mass. Bile cyst large, elongated, cylindrical, 4 mm. long by 2 mm. in diameter, opening into the stomach close to its cardiac end and entirely concealed by that organ, behind and below which it lies.

Hermaphrodite gland, closely covering the whole surface of the liver, yellowish. The hermaphroditic duct rises from the anterior end of the right lobe of the visceral mass with a diameter of 0.3 mm. and is very short, dilating at 1 mm. length into the whitish ampulla. The ampulla passes forward in a sinuous course, with an average diameter of 1 mm., to the anterior end of the genital mass, where it is closely looped into a coil and divides into the vas deferens and the oviduct. Its total length is about 24 mm., with an average diameter of 1 mm.

The anterior genital mass is large, plano-convex in form, its flattened side dorso-posterior, nearly circular in outline, its diameter about 11 mm., the convex surface directed outward and downward. The ventral and posterior margins are sharp, the anterior and dorsal ones rounded and occupied by the coils of the hermaphroditic ampulla and vas deferens, and the spermatotheca, respectively.

The everted glans penis is conical, unarmed, long and rather slender, about 7 mm. long by 1 mm. in diameter at the base, the tip blunt and flattened, recurved upward and backward. The preputium is conical and thick, about 3 mm. long. The muscular vas deferens arising from it, describing a number of closely coiled loops, passes along the anterior external margin of the genital mass to its origin as a branch of the hermaphroditic ampulla with no trace of a prostate gland along its course. Total length of vas deferens when straightened out about 28–30 mm., its average diameter 0.5 mm.

The vaginal opening is situated immediately behind the penis, above the duct of the nidamental gland, its duct slender, 0.5 mm. wide, coursing obliquely upward to the posterior end of the spermatotheca and opening into it after a slightly sinuous course of about 1 mm. (pl. xviii, fig. 4, *vd.*). The spermatotheca (pl. xviii, fig. 4, *sp.th.*) is spherical, thin-walled, about 5 mm. in diameter, lying on the upper margin of the genital mass and concealing the spermatocyst and its duct, which lie immediately outside and below it. It receives at its posterior end the very short common duct of the spermatocyst and the vagina. The spermatocyst (pl. xviii, fig. 4, *sp.c.*) is elongate, pear-shaped, its length 3 mm., its diameter 1.5 mm., pinkish in color, its duct as long as the cyst, with a diameter of 0.3 mm. and coursing backward under the spermatotheca on the upper outer convex face of the genital mass to unite with the very delicate uterine duct. The latter duct (pl. xviii, fig. 4, *u.d.*) 0.2 mm. long by 0.1 mm. in diameter, runs forward and passes into the nidamental gland close to the oviduct.

The nidamental and albumin glands form the greatest portion of the anterior genital mass and consist of a peripheral more translucent portion made up of closely coiled tubules inclosing a denser, more centrally placed white part, the other relations of the glands as usual in the genus.

The species which is here identified with *A. montereyensis* (Cooper) is comparatively common in Monterey Bay, occurring in rocky tide pools at nearly all seasons of the year. It is especially abundant on the piles of the wharf at Monterey, where it is found in company with the form next described and with which it might be readily confused at first sight. *A. montereyensis*, however, does not attain one-half the size of the latter, the distribution of the dark spots upon the dorsum is markedly different, and the tentacles are altogether unlike, being in *A. montereyensis* flattened and auriculate, with an external groove, while in *Anisodoris nobilis* they are elongate and digitiform. An examination of the internal anatomy reveals very important points of difference, notably the absence of a prostate gland in this species, while in *Anisodoris nobilis* a very large prostata is present.

A specimen deposited in U. S. National Museum (no. 181285).

Genus 2. **ANISODORIS** Bergh.

Anisodoris Bergh, Die Opisthobranchien der Sammlung Plate, Fauna Chilensis, Heft 3, 1898, p. 508.
Montereina MacFarland, op. cit., p. 38.

Form of body, tentacles and branchiæ as in *Archidoris.* Large prostate gland present. Vagina and penis unarmed.

In my preliminary paper upon the Dorididæ of Monterey Bay, a new genus, *Montereina*, was proposed for the reception of a species which differed strikingly from the other genera of the Archidoridinæ. My description of this form was written in 1894 practically as it appeared in 1905 in the paper cited above, and inadvertently, in revising the manuscript, the important paper of Bergh (1898) upon the Opisthobranchs of Chile in the Plate collection was overlooked. A new genus, *Anisodoris*, with which *Montereina* is practically identical, is described in this paper by Bergh. The slight difference of long cylindrical tentacles in the Monterey form is hardly sufficient to warrant its retention as a distinct genus, and *Montereina* must therefore be regarded as a synonym. To the genus *Anisodoris* Bergh has assigned the following species, all from Chile: (1) *An. punctuolata* (d'Orbigny). (2) *An. variolata* (d'Orbigny). (3) *An. marmorata* Bergh. (4) *An. tessellata* Bergh.

To this list is here added the following Monterey form, which is distinct from these. The genus thus far appears to be limited to the Pacific coast of North and South America.

2. **Anisodoris nobilis** (MacFarland).

[Pl. XVIII, figs. 6-11; pl. XXII, figs. 1 and 2.]

Montereina nobilis MacFarland, op. cit., p. 38.

Body very large, plump, arched, but little depressed, sloping abruptly in front (pl. XXII, fig. 1), less so behind. Broad, elongate, elliptical in outline, the ends nearly equally rounded. General ground color a rich orange yellow, varying to light yellow in some specimens (pl. XXII, figs. 1, 2). Dorsum thickly tuberculate, the tubercles slightly inflated at the outer end, giving them a knob-like appearance. The largest tubercles are 1.5 mm. in diameter by 2 mm. in height, decreasing in size as the mantle margin is approached. Between the large tubercles smaller ones are everywhere closely set. Dorsum mottled everywhere between the tubercles with irregular blotches of dark brown or black. The total amount of this mottling may vary within wide limits, some individuals being quite light yellow while others are very dark (pl. XXII, fig. 2). Branchial plumes pinkish, tipped with white.

Length up to 20 cm., width to 6 cm., and height up to 3 cm.

Mantle everywhere projecting far beyond the foot save behind, where the tip of the tail protrudes for varying lengths. Sides of body not high, smooth, light yellow.

Foot broad, smooth, light yellow in color, abruptly rounded in front, more gradually so behind, its anterior margin bilabiate with a slight median notch.

Mouth relatively small, lips fleshy, the oral tentacles digitiform, bluntly conical, 5 mm. long, directed forward and curved outward toward the tips (pl. XVIII, fig. 6).

Rhinophores stout, the stalk conical, the clavus perfoliate with about 24 leaves, deeply retractile within low sheaths, the margins of which are tuberculate.

Branchial plumes 6, large, spreading, tri- and quadripinnate, when fully extended covering the whole of the posterior dorsum. A thin membrane-like expansion joins the bases of the plumes.

Anal papilla large, cylindro-conical, blunt, occupying the center of the circle of branchiæ.

Renal papilla small, at right and in front of anal papilla, between the bases of the first and second anterior plumes on right side.

Blood glands in two distinct portions of nearly equal size, both flattened, finely lobulate, and irregular in outline. The anterior gland lies in front of the cerebral ganglia upon the pharyngeal bulb, is oval in general outline, the broader, thicker portion directed posteriorly. Length about 5 mm., width 4 mm. The posterior gland is transversely placed immediately behind the cerebral ganglia, extending on the right over a part of the anterior genital mass. Length 5 mm., width 6 mm.

Pharyngeal bulb large, conical, its length about 10 mm., width 8 mm., and height 6 mm., the radula sac projecting behind and below as a rounded cylindrical process of 4 mm. length. Lip disk 5 mm. in diameter, covered with a thick colorless cuticula, the opening an inverted T-shaped cleft.

Radula broad and short, deeply grooved, colorless or nearly so, the rhachis very narrow, naked. Teeth in 26 rows, the last 2 being immature. Pleural teeth large, strongly hooked, 55 in anterior rows, 60 in the middle rows, and 62 in the posterior rows. The general type of the pleural teeth is much the same as in Archidoris, the outer face being more convex than the inner. The outermost teeth increase rapidly in size toward the center of the row (pl. XVIII, fig. 7), the shaft and hook being nearly at right angles. The teeth from the middle portion of the row (pl. XVIII, figs. 8 and 11) have strongly curved hooks, much more so than in *Archidoris montereyensis* (cf. pl. XVIII, fig. 3), while the wing-like expansion along the inner margin of the shaft is but slightly developed. The innermost pleural teeth (pl. XVIII, figs. 9–10) decrease slightly in size, possess strong, curved hooks, strongly convex outer and concave inner and dorsal surfaces of the shafts.

Salivary glands long, narrow, band-like, passing backward near median line on floor of the body cavity beneath the stomach, with a total length of 15 mm. and a width of 2 mm. at anterior end and gradually narrowing posteriorly.

The thin-walled œsophagus leads directly backward to the large S-shaped stomach lying in a broad notch in the anterior end of the liver, its cardiac end below and in median line. The organ curves upward and to the left, its pyloric end passing obliquely forward to the right side into the intestine, receiving the broad bile duct on the posterior lower surface near the cardiac end. Length, about 24 mm., greatest diameter about 8 mm., these dimensions varying with the degree of distension. The intestine is a stout tube about 3 mm. in diameter at its origin from the pylorus, curving upward and diagonally backward from left to right in front of the stomach, and coursing backward in a deep groove on the dorsal surface of the visceral mass at the right of the median line to the anal papilla, in the center of the circle of branchiæ. Total length about 40 mm., its inner surface longitudinally plicate. The liver is bluntly conical in shape, yellowish, closely covered by the hermaphrodite gland, its apex directed posteriorly. In front is a deep wide cleft occupied by the stomach, above a dorso-lateral longitudinal groove for the intestine, the right anterior lobe flattened into facets by the pressure of the anterior genital mass.

The hermaphroditic gland is yellowish, thin, closely invests the liver, and at its anterior upper border gives origin to the short, narrow, straight hermaphroditic duct, 2 mm. long by 0.3 mm. wide, which passes directly forward to the anterior genital mass, dilating into its wide, whitish ampulla, which is closely looped upon the inner anterior face of the mass. The diameter of the hermaphroditic ampulla is 1 mm., its length about 8 mm.

The anterior genital mass is large, its outer surface convex, its inner rounded in front and beveled obliquely from within outward behind. At its anterior inner margin the distal end of the hermaphroditic ampulla passes into the substance of the nidamental gland and divides into the spermatic duct and the oviduct. The former duct is short and narrow, passing almost at once into the large, whitish yellow prostate gland which lies upon the upper surface of the anterior genital mass. It is a large ovoidal body, with smooth outline, about 6 mm. long by 3 mm. in greatest diameter, convex above and flattened below. From its distal extremity passes the long, slender vas deferens, about 22 mm. in length by 0.6 mm. in greatest diameter, convoluted into a number of close loops along the anterior border of the genital mass, and dilating into the thick, conical penis (præputium), which is 2.4 mm. wide by 4 mm. long (retracted), with a short, conical, unarmed glans.

The uterine duct receives the duct of the spermatocyst a short distance from its point of emergence from the nidamental gland. The spermatocyst is spherical, 1.5 mm. in diameter, with a short duct about as long as the cyst. The large spherical grey spermatotheca, 5 mm. in diameter, is situated in the posterior half of the anterior genital mass, and receives the oviduct on its lower anterior surface close to the point of origin of the vaginal duct. The latter is about 10 mm. long and 0.3 mm. in diameter, dilating gradually at its distal end into the unarmed vagina. The nidamental and albumin glands are large, their structure and relations usually as in the Archidoridinæ.

Habitat: In rocky tide pools all along the coast of Monterey Bay from Monterey to Point Lobos and beyond. An abundant species found at all seasons of the year, most common during the summer months, and the largest dorid found in the bay up to the present time. Its bright yellow color makes it a very conspicuous object at low tide. Usually very abundant on the piles of the wharf at Monterey in company with the smaller *Archidoris montereyensis*.

Type no. 181284, U. S. National Museum.

Subfamily IV. DISCODORIDINÆ.

Body not hard, depressed; notæum minutely granuligerous, pallial margin rather wide; tentacles digitiform; branchial leaves nearly always tri- or quadripinnate; foot rather wide. Labial armature (labial lamellæ) made up of extremely minute, closely packed rods. Rhachis of radula naked, pleuræ multidentate, the teeth hooked. Penis usually unarmed.

Genus 3. DISCODORIS Bergh.

Discodoris Bergh, Jahrbücher d. deutschen malacozoologischen Gesellschaft, IV, 1877, p. 61. Mal. Unters., XII, 1877, p. 518; Sup. I, 1880, p. 47; II, 1881, p. 108; XV, 1884, p. 678; XVI, 1, 1888, p. 805; XVII, 1890, p. 895. Rep. on Nudibr., Challenger Reports, X, 1884, p. 92. System der Nudibr. Gasteropoden, 1892, p. 102.

Body rather soft, rounded or oval in outline; the branchial aperture slightly crenulate, stellate, or bilabiate; anterior margin of the foot bilabiate, the upper lip more or less notched. Prostate gland large.

3. Discodoris heathi MacFarland.

[Pl. XXIII, fig. 6; pl. XVIII, figs. 12-17.]

Discodoris heathi MacFarland, op. cit., p. 39.

Body elliptical, broad, depressed; the notæum minutely tuberculate, nearly smooth. General color light yellow, darker toward the median line; the notæum sprinkled everywhere with extremely minute black or brown spots, giving the animal a general dusty appearance. Irregularly scattered over the dorsum a variable number of black, brown, or brownish-red flecks, the majority of them in the mid-dorsal region. (Pl. XXIII, fig. 6.) In alcohol the yellow color is lost and the dark spots become lighter.

Mantle margin thin, wide, crenulate, extending far beyond the foot, except at the tip of the tail. The foot rather narrow, its anterior end abruptly rounded, bilabiate; the upper lip deeply notched, the tail short and blunt.

The head is small and inconspicuous, being almost concealed by the mantle; the oral tentacles long and cylindro-conical (pl. XVIII, fig. 12), curved outward.

Rhinophores (pl. XXIII, fig 6) moderately large, cylindro-conical, the stalk stout, the clavus perfoliate with 10–15 leaves; the whole organ retractile within a sheath with low, thin, slightly sinuous or lobed margin. Color of the rhinophores slightly darker than the mantle, thickly sprinkled with minute black spots.

Branchial plumes 8–10, tripinnate, small, spreading, whitish-yellow, sprinkled with minute black spots, deeply retractile within a low sheath, the margin of which is similar to that of the rhinophores. Plumes arranged in an incomplete circle, closed behind by the low, conical anal papilla. Renal opening on the right and slightly anterior to the base of the anal papilla.

Total length of the animal up to 30 mm., its width 15 mm., and height 6 mm.

Mantle thick, fragile, densely spiculate, its inner surface thickly strewn with minute black spots and a few of the same color scattered over the pseudo-peritoneum above the central nervous system.

Pharyngeal tube large, conical, 2 mm. long, dilating rapidly into the large pharyngeal bulb, about 4.5 mm. in length, 3 mm. wide and 2.5 mm. high, the rounded end of the radula sac projecting behind and below for a distance of 1 mm.

Labial disk elliptical, convex, the opening vertical, slit-like, a lateral fold on either side about one-third the distance from the bottom to the top of the opening. The armature is light yellow in color and consists of short, closely set rods with squarish ends about 42 μ long by 3.5 μ wide, arranged in two lamellæ on the upper half of the sides of the opening. Each lamella is approximately quadrangular in shape, the upper border prolonged backward in a triangular point (pl. XVIII, fig. 15). Length of upper border 0.750 mm., of lower border 0.525 mm., height of lamella 0.750 mm.

Radula colorless, twice as long as wide, not deeply grooved. The teeth in 20 rows, with 36–42 teeth in each row. Rhachis narrow, naked. Pleuræ with 36–42 strongly hooked teeth (pl. XVIII, fig. 13, 14). The first 20–25 of these vary but little in size, the hook slightly increasing in length, the shaft obliquely curved toward the median line of the radula and bearing a thin, wing-like expansion on its inner side. The outermost 12–16 pleuræ decrease very rapidly in size, are fitted closely together, and become reduced to thin concave plates.

The anterior genital mass is quite large, occupying the side and floor of the cavity in front of the liver. Its outer face is convex, the inner side presenting two faces oblique to each other and of about equal size, the crest between them being occupied by the spermatocyst.

The hermaphroditic duct (pl. XVIII, fig. 16, *hd.*) emerges from the anterior lobe of the visceral mass, is very delicate and short, and dilates almost immediately into its ampulla (pl. XVIII, fig. 16, *ha.*) upon the posterior inner face of the genital mass. The ampulla is large, grayish, 1 mm. in diameter by 10 mm. in length, describes a short loop backward and then courses forward along the outer surface of the proximal loop of the prostate gland to the anterior face of the genital mass, where it narrows, gives off the spermatic duct, and passes on as the oviduct (pl. XVIII, fig. 16, *sp. d. ov.*).

The penis (præputium) is 2 mm. long by 8 mm. in diameter, the everted glans is bluntly conical, short, and unarmed. The vas deferens (pl. XVIII, fig. 16, *v. def.*) is very long, narrow, looped upon the anterior face of the genital mass, 0.5 mm. in diameter by about 15 mm. long, and passes into the thick, pinkish-yellow prostate gland (pl. XVIII, fig. 16, *pr.*), which lies in a loop directed posteriorly along the lower, inner margin of the genital mass, its inner portion pinker and more distinctly lobulated than the outer turn of the loop. Length of prostate 14 mm., its greatest diameter 2.5 mm. At the lower margin of the anterior face the gland contracts into the short spermatic duct, which branches off from the distal end of the hermaphroditic ampulla.

The small spermatocyst is oval in shape, 1 mm. long, and lies upon the vaginal duct, its duct quite short and opening into the uterine duct (pl. XVIII, fig. 17, *sp. c.*). The spermatotheca is large, somewhat oval in outline, 3 mm. in longest diameter, and lies upon the crest between the inner anterior and posterior faces of the genital mass. Its two ducts join it close together (pl. XVIII, fig. 17, *sp. th.*) the vaginal duct passing straight outward laterally (pl. XVIII, fig. 17, *vag. d.*) and dilating into the vagina, its length being about 3 mm., its average diameter 0.4 mm.

The large albumin gland makes up a large portion of the genital mass, occupying the outer and lower part, the yellowish nidamental gland being inclosed by it and exposed on the inner and posterior faces of the mass. A long, flattened, narrow vestibular gland lies on the outer posterior face of the genital mass and opens into the vestibulum close to the vagina.

Habitat: In rocky tide-pools from Point Pinos to Monterey, rather rare. Usually most easily found during July and August, but has been taken during the winter months as well.

The species name is given in honor of Dr. Harold Heath, assistant professor of zoology in Stanford University, who has done excellent work upon the mollusca and to whose willing cooperation the author owes much assistance in collecting Pacific coast nudibranchs.

Type no. 181282 U. S. National Museum.

Genus 4. ROSTANGA Bergh.

Rostanga Bergh, Gatt. nördlischer Doriden, Arch. f. Naturgesch., XLV, 1, 1879, p. 353. Malacol. Unters. Sup. H, II, 1881, p. 99. System der Nudibr. Gasterop., 1892, p. 106.

Notæum covered with minute hispid papillæ; branchiæ of simply pinnate leaves. Rhachis of radula naked; inner pleural teeth strong, with large body and small hook; the remaining ones less strong, erect, the body smaller, the hook elongated and more slender, the apices of the outer pleuræ with slender denticles.

4. Rostanga pulchra MacFarland.

[Pl. XXIV, fig. 8; pl. XVIII, figs. 18–21; pl. XXI, fig. 109.]

Rostanga pulchra MacFarland, op. cit., p. 40.

Body elliptical, slightly depressed, the sides nearly parallel, the ends of body equally rounded, the mantle ample, covering the whole body except the tip of the tail when the animal is crawling. General ground color (pl. XXIV, fig. 8) bright red, varying at times from light yellowish red to deep scarlet, the back sprinkled everywhere with minute brown and black spots between the papillæ. The number of these spots is highly variable, in some individuals being very small, in others thickly set and often grouped in small patches, deepening the general color of the animal to a reddish brown. In alcohol the red color is quickly lost, the more permanent brown becoming very conspicuous upon the light yellowish white of the rest of the animal.

Dimensions of largest individual taken, 18 mm. in length, 10 mm. breadth, 5.5 mm. height, the average size usually found, however, being about 8–12 mm. long.

Dorsum covered everywhere with small, closely set, hispid papillæ, in height ranging up to 0.42 mm. in diameter to 0.08 mm., strengthened by divergent spicules extending from base to apex, the central portion of apex sunken and surrounded by the higher margin, elevated at intervals by the spicules into pointed projections.

Sides of foot nearly parallel, abruptly rounded in front, more tapering behind. Anterior margin deeply bilabiate (pl. XXI, fig. 109), the upper lip projecting beyond the lower, notched in the median line. Oral tentacles long and slender. General color of the ventral surface of foot, mantle, and sides of body a lighter red than the dorsum, rarely with fine black sprinklings.

Rhinophores (pl. XXIV, fig. 8) short, stout, translucent pink, the stalk stout and conical, prolonged above the clavus as a blunt, cylindrical process, nearly one-fourth the length of the whole organ. Clavus perfoliate, bearing altogether from 20–24 nearly vertical leaves (10–12 on each side). The leaves rather thick, triangular, with the apex directed downward, increasing in size regularly from before backward. Tip of rhinophore directed forward, the rest of the organ nearly vertical. Rhinophore entirely retractile within sheath, the margin of which is not appreciably elevated above the surrounding dorsum, and bears papillæ similar to those of the general dorsal surface.

Branchial plumes 10–12, erect, separate, nearly equal in size, slightly paler than dorsum, arranged in a circle, completely retractile within a sheath the margin of which is scarcely elevated and bears papillæ similar to those of the dorsum. Anal opening upon a low papilla in the center of the circle of branchiæ, the minute renal opening at its right and slightly in front.

Labial disk round, convex, covered with thick colorless cuticula, its opening ⊥ shaped. The lower half of the sides of the opening is occupied by a crescentic band of flattened hooks, the slightly concave border being directed forward, the upper angle much in advance of the lower, the lower ends being separated by a narrow space. Length of the armature, 0.24 mm.; its greatest width, 0.072 mm. The elements of the armature are arranged in 5 rows closely overlapping each other, their general shape being the same. The hooks of the most anterior row are blunt, flattened, and but slightly elevated and directed forward, the base rounded in front, the upper surface sloping backward beneath the hooks of the succeeding row. The elements of the remaining rows progressively decrease in size, the hooks are shorter and pointed. Length of longest element of the most anterior row, 21 μ; its width 6 μ, decreasing in the last row to a length of 6 μ, and a width of 5 μ (pl. XVIII, fig. 21).

Radula broad, colorless, the median groove deep. Teeth in 65–80 rows, with 81 teeth in each row. Rhachis naked.

First pleural tooth thick, stout, the base short and broad, its hook heavy, slightly curved with 8–11 small denticles upon its inner margin (pl. XVIII, fig. 18*a*). Height of base to apex of hook about 0.013 mm., the length of hook 0.008 mm. The succeeding 10 pleural teeth have a large, strong, broad base bearing a wing-like expansion thickened above upon its outer border, overlapping the adjacent tooth (pl. XVIII, fig. 19). The hook is strong and thick, increasing in length and becoming more slender from about the twelfth tooth outward, the base diminishing in size, the hook longer, more slender, and less curved (pl. XVIII, fig. 20*a*), passing over rather rapidly into long, slender elements (pl. XVIII, fig. 20*b*, *c*), each with a small, compressed, wing-like base and long, slender, slightly curved hook, bearing at the distal end from 1 to 6 very long denticles upon the inner margin. These denticles arise in the distal third of the hook and, increasing slightly from within outward, reach nearly to the tip of the tooth and give it the appearance of being divided (pl. XVIII, fig. 20*c–f*). The outer teeth of the rows are very flexible and slender, thus giving to this portion of the radula a brush-like appearance.

The hermaphrodite gland extends over the dorsal, lateral, and anterior faces of the liver as a thin layer, varying from 0.18 mm. to 0.3 mm. in thickness, being at its maximum about one-third the thickness of the liver in the same section. From its right anterior lobe arises the very narrow and short duct which extends obliquely forward and downward to the hermaphroditic ampulla. The anterior genital mass is large, being at least half as large as the hermaphrodite gland and liver combined. From above it is rectangular in outline, 3.2 mm. wide by 3 mm. long by 2 mm. thick. The hermaphroditic ampulla is whitish, slightly curved vertically, the convex face directed downward, 2.5 mm. long, with a greatest diameter of 0.5 mm. It courses anteriorly along the ventral face of the anterior genital mass in a groove between the nidamental gland and the spermatotheca. Its anterior end curves upward and enters the nidamental gland at its anterior inner face, giving off the spermatic duct and the uterine duct at its entrance.

Nearly two-thirds of the bulk of the anterior genital mass is made up of the very large, nearly spherical spermatotheca. In sections it measured 0.76 mm. high by 0.93 mm. long in an individual of 6.6 mm. total length, the transverse diameter in sections of another individual of the same size being 0.975 mm. It is lined with a single layer of large cubical ciliated cells becoming flattened posteriorly. The uterine and vaginal ducts open into it upon its outer and upper surface close together. The thick walled vaginal duct passes directly outward from it into the vagina, the thinner and shorter uterine duct receives the duct of the oblong-oval spermatocyst and curves directly downward to its origin as a branch of the hermaphroditic ampulla close to the entrance of the latter into the nidamental gland. The spermatocyst is about 0.52 mm. long by 0.22 mm. wide and lies transversely upon the upper anterior outer face of the anterior genital mass.

The spermatic duct dilates into a broad thin prostate gland which nearly envelops the spermatotheca, leaving only a small portion of its ventral surface free. The gland has thin walls and a large, sac-like lumen which passes anteriorly into the vas deferens. The vas deferens courses to the left and at about the median line loops back toward the right, passing straight outward and downward into the muscular penis (preputium). The retracted glans is blunt, cylindrical, of 0.3 to 0.5 mm. in length and about 0.15 mm. in diameter, and is entirely unarmed.

Habitat: Abundant everywhere along the coast in rocky tide-pools from Monterey to Point Lobos, upon a red sponge which incrusts the under side of overhanging rocks, and with which it is nearly identical in color. Has been taken at all times of the year in apparently equal abundance. The egg bands are of the usual form characteristic of the Dorididæ, a narrow flat ribbon attached by one edge in a closely wound coil to the sponge or to the rock, and of the same color as the animal. The spawn of *R. coccinea* Forbes as described by Alder and Hancock (Monograph British Nudibranchiate Mollusca, 1848) is white, while in hundreds of cases of that of *R. pulchra* seen by me it has always been bright red, and has been found at all times during the year.

Rostanga pulchra differs strikingly externally from the two previously known species of the genus—*R. coccinea* Forbes and *R. perspicillata* Bergh—in lacking the yellowish or whitish area around and connecting the rhinophores, but especially in the structure of the radula and labial armature, as shown in the following tabulation:

	R. coccinea.	R. perspicillata.	R. pulchra.
Color	Scarlet, sprinkled with black spots. Yellowish area around rhinophores and connecting them.	Brownish red or brick red, dotted with black spots. White area around rhinophores and connecting them.	Uniform bright red or scarlet sprinkled with dark spots.
Rows in radula	51-66.	51-57.	65-80.
Teeth in row	60-65.	50-70.	81.
First pleural tooth	No denticles on the hook	With 4-6 denticles on hook	With 8-11 denticles on hook.
Outer pleuræ	With 1 long denticle	With 1 long denticle	With 1-6 denticles.
Labial armature	A ring of rods in 12-15 rows, interrupted above and below.	A ring of 20 rows of rods	A slightly curved oblique crescent of 6 rows of hooks on each side.

Bergh (Mal. Unters., Sup. Heft II, 1881, p. 102) gives the labial armature of *R. coccinea* as a ring 0.18 mm. broad, apparently interrupted above and below and made up of 12–15 rows of closely packed stout rodlets up to 0.05 mm. in length, the most anterior ones with slightly enlarged distal ends. Serial sections of *R. coccinea* secured at Naples for comparison show this armature as a band of rodlets, clearly interrupted above and below, having a vertical breadth of 0.21 mm., the uppermost rodlets 0.006 mm. in height by the same in width, and increasing progressively in the succeeding rows below to 0.048 mm., the diameter remaining the same. In *R. perspicillata* Bergh (op. cit., p. 106) the labial armature forms a continuous ring of about 20 rodlets, in the broadest portion reaching 0.05 mm. in length. In *R. pulchra*, as described above, the elements of the armature are in the form of flattened hooks, overlapping each other closely and arranged in but 5 rows, ranging in length from 0.006 mm. to 0.021 mm. The whole armature is in the form of a crescentic band on either side, the concave face directed forward.

The relatively enormous spermatotheca and its relation to the prostate gland is a characteristic separating *R. pulchra* clearly from *R. coccinea* and *R. perspicillata*.

Type no. 181292, U. S. National Museum.

Subfamily V. DIAULULINÆ.

Body neither hard nor soft; depressed or subdepressed; notæum usually minutely villous, often silky; tentacles digitiform; branchial aperture rounded, crenulate, branchial leaves tripinnate; anterior margin of foot bilabiate, upper lip notched. Labial armature none. Rhachis of tongue naked. Pleuræ multidentate, usually hooked. Penis usually unarmed.

Genus 5. DIAULULA Bergh.

Diaulula Bergh, Gattungen nördischer Doriden, Arch. f. Naturgesch. XXXV, 1879, p. 343. On the Nudibranchiate Gasteropod Mollusca of the North Pacific Ocean (Sci. Results of the Explor. of Alaska, I, Art. VI), Proc. Acad. Nat. Sci. Philadelphia, 1880, pp. 40–46. System der Nudibr. Gasterop., 1892, p. 105. Die Opisthobranchien, Bulletin Mus. Comp. Zool. Harvard, XXV, 10, 1894, pp. 171–175.

Body fairly soft and depressed; notæum silky, minutely villous; tentacles digitiform; branchial aperture rounded, crenulate, branchiæ tripinnate; foot rounded in front, bilabiate, upper lip notched in median line. Labial armature, none. Rhachis of tongue naked. Pleuræ multidentate, teeth hooked. Penis unarmed, prostate large.

5. Diaulula sandiegensis (Cooper).

[Pl. XXIII, fig. 5; pl. XVIII, figs. 22–24.]

Doris (*Actinocyclus?*) *Sandiegensis* Cooper, Proc. Cal. Acad. Nat. Sci., II, 1862, p. 204; III, 1863, p. 58.
Diaulula sandiegensis Bergh, Nudibr. Moll. North Pac. Ocean, Proc. Acad. Nat. Sci. Phila., 1880, pp. 40–46.—MacFarland, op. cit., p. 41.

Body soft, elliptical, velvety, the ends equally rounded, somewhat depressed. Mantle extending beyond the head and foot everywhere except at the tip of the tail when the animal is crawling. Edge of mantle wide and thick, slightly crenulate, projecting 6–8 mm. beyond sides of body in alcoholic material. Dorsum everywhere minutely villous and velvety, pale yellowish in color with dark brown or black rings of varying size, number and position (pl. XXIII, fig. 5). In general these rings are arranged in two longitudinal series on each side of the median line with 3–6 rings in each row, but this is subject to much variation. The number may be increased to 20–30 irregularly scattered ring-like blotches or may be reduced to 2 or 3 very faint ones, and between these extremes all gradations may occur. The largest rings noted measured 8 mm. in diameter, though the average size is nearer 4 mm. for the large ones. Small patches of brown may also occur among the rings. The general color of the dorsum may vary from light yellow to deep brownish yellow or even chocolate.

Head entirely concealed by mantle, the mouth a vertical slit, the tentacles about 3 mm. long, finger-like.

Foot elongate oval, the ends rounded, the anterior end deeply bilabiate, the upper lip thinner, broader, and bearing a median notch.

Rhinophores conical, dilated in the clavus, perfoliate, with about 20–30 leaves, deeply retractile into a conspicuous sheath with crenulate margin.

Branchiæ 6 deeply retractile, tripinnate plumes inclosing the anal papilla in a nearly complete circle. Margin of the branchial sheath prominent, crenulate. Anal papilla conspicuous, conical, 3 mm. high, 1.5 mm. in diameter, attached anteriorly to the basal branchial ridge. Renal opening at right and in front of anal papilla, inconspicuous.

Pharyngeal bulb not large, about 4 mm. long, 2–3 mm. high and 3.5 mm. broad, the radula sheath very prominent on the lower hinder margin, projecting as a compressed, rounded, keel-like structure for about 1.5 mm. No labial armature save a simple cuticula.

Radula rather broad, about twice as long as wide in anterior portion, yellow. Teeth in 19–22 rows with from 26–30 teeth in each half row.

Rhachis broad, naked. Pleural teeth similar in shape, strongly falcate, compressed, the inner 2 or 3 (pl. xviii, fig. 22) smaller than those following, the outermost ones also strongly reduced in size (pl. xviii, fig. 23). Upon the inner side of each tooth a narrow wing-like expansion which is continued as a decreasing thickening up along the back of the tooth toward the tip (pl. xviii, fig. 24).

Habitat: In rocky tide pools of the fucoid zone all along the southern coast of Monterey Bay. Not abundant but has been taken at all times of the year. The species has a wide range, having been recorded from Sitka, Unalaska, Puget Sound, Monterey Bay, Santa Barbara, and San Diego, and in a light colored variety, *D. sandiegensis*, var. *pallida* Bergh NNE. of Punta Delgada, off the coast of Patagonia in S. lat. 42° 24′, W. long. 61° 38′.

At Monterey the breeding season occurs principally during the summer months, but individuals have deposited their eggs in the aquaria at the Hopkins laboratory in December and January, and the broad white spiral egg bands of this species have been found in the tide pools at the same time, though not as abundantly as during the months of June, July, and August.

This species was discovered and superficially described by Cooper (1862) and afterwards more fully by Bergh (1880), whose careful account of the anatomy of the form, based upon specimens from Alaska, is amply sufficient for its ready recognition.

A specimen deposited in U. S. National Museum (no. 181288).

Genus 6. **ALDISA** Bergh.

Aldisa **Bergh**, Malacol. Unters., H. XIV, 1878, p. XXXVIII. Gattungen nördischer Doriden, Arch. f. Naturgesch., XLV, 1, 1879, p. 348. System der Nudibr. Gasteropoden, 1892, p. 106. Nudibranches et Marsenia provenant des Campagnes de la Princesse-Alice (1891–1897), Rés. Camp. Sci. Albert Ier de Monaco, Fasc. XIV, 1899, p. 7.

Tentacles tubercule-like or auriform. Pleural teeth erect, rod-like, the external margin serrulate. Glans penis armed.

6. **Aldisa sanguinea** (Cooper).[a]

[Pl. xxiv, fig. 7; pl. xviii, figs. 25–26; pl. xxi, figs. 112, 114.]

Doris (*Asteronotus*) *sanguinea* Cooper, Proc. Cal. Acad. Nat. Sci., II, 1862, p. 204; III, 1863, p. 58.
Asteronotus? sanguineus Bergh, System der Nudibr. Gasteropoden, 1892, p. 111.
Aldisa sanguinea MacFarland, op. cit., p. 42.

Body somewhat depressed, oval, the ends about equally rounded. Dorsum everywhere thickly covered with small conical tubercules, the general color light to dark red (Pl. xxiv, fig. 7), sprinkled everywhere with very minute black spots. On the median line immediately in front of the branchiæ a large rounded or oval spot of black, another similar spot in median line just behind the rhinophores, which often is very much elongated or divided into 2, one behind the other. These spots may vary in size and number, but seem to be quite constant in color marking. In alcoholic specimens the black spots become greenish, the red color disappearing entirely.

Margin of mantle rather thick, covering the foot everywhere, except at the extreme tip of the tail, when the animal is crawling.

The foot is abruptly rounded in front, less so behind, the sides slightly converging posteriorly. Anterior margin of foot bilabiate, the upper lip thin, undivided. Color everywhere beneath light to dark red.

Total length up to 17 mm. with a width of 8 mm. and a height of 6 mm. Length of foot of same specimen, 13 mm; its greatest width, 6 mm.

Head small, concealed between mantle and foot; the tentacles short, auriform, with a clearly marked external longitudinal groove.

Rhinophores rather stout, the stalk cylindro-conical, the clavus dilated, conical, tapering to a blunt tip, perfoliate with about 12–15 leaves, the whole organ deeply retractile into a sheath, the low margin of which bears scattered, rounded tubercules, similar to those of the dorsum.

Branchial plumes, 8–10, simply pinnate or irregularly bipinnate, arranged in a circle, completely retractile into a sheath, with low tuberculate margin. Anal papilla low, centrally placed.

Blood gland very thin and small, the anterior lobe almost rudimentary, the posterior lobe lying transversely upon and behind the central nervous system.

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[a] Cooper's very fragmentary description is as follows. "Brilliant red, with a few large black spots irregularly distributed. Surface smooth; dorsal tentacles short; branchiæ composed of 8 simply pinnate rays, extending close to the posterior end of the body. Length, ½ inch, breadth, ¼ inch, height, about the same."

Pharyngeal tube large, funnel-shaped, the large lip disc thickened and glandular, with rather strong cuticula. In sections a delicate armature of extremely fine short rodlets may be made out. The pharyngeal tube is continuous into the pharyngeal bulb, with no sharp line of demarcation externally. The latter is somewhat conical, strong, and about 2.5 mm. long, inclusive of the radula sheath, which projects slightly behind.

The radula is rather wide, colorless, the teeth in about 70 rows. The rhachis is narrow, naked, the pleural teeth very numerous and slender, at least 70 to 100 in each half row, and of very striking form, which readily marks out this genus from any other of the Dorididæ. Each tooth is composed of a slender shaft arising from a strongly compressed, triangular base of uniform or but slightly changing size (pl. xviii, figs. 25, 26*b*); its distal end is slightly enlarged, slightly hollowed behind, and bears on its thickened external and upper projecting margins a single series of extremely small denticulations, which are continued down the outer border of the shaft for varying distances, in some cases reaching ½ the length of the tooth (pl. xviii, fig. 26*a*). The inner teeth are the longer, having a length of about 0.5 mm.; the outermost are much shorter, ranging down to 0.03 mm. The diameter of the shaft averages 0.003 to 0.004 mm., increasing gradually toward the distal end, where it measures 0.006 mm. to 0.008 mm. All the elements of the radula are very flexible, and the most careful manipulation is necessary to avoid bending and disarranging them.

The short œsophagus passes directly backward to the stomach, which lies in the anterior cleft of the liver. Its relations and those of the intestine are the usual ones in the Dorididæ. The liver is bluntly conical, the broader end directed forward with a deep median cleft occupied by the stomach. Above the liver is slightly flattened and behind is bluntly rounded. Its length in a large individual (16 mm. long) was 4.5 mm., with a greatest diameter of 3.5 mm. The right anterior lobe formed by the median cleft is shorter than the left one and faceted by the pressure of the anterior genital mass.

The ovotestis is a lobulated organ closely attached to the dorsal and anterior surfaces of the liver. In thickness it is nearly equal to the latter organ and thus makes up at least one-half of the bulk of the two. From the inner face of its left lobe the hermaphrodite duct is given off, passing immediately below the pyloric end of the intestine downward and to the right, in front of the lesser (anterior) curvature of the stomach, thence obliquely forward beneath the spermatotheca to dilate into the hermaphroditic ampulla. It is much larger than in Dorididæ of similar dimensions, reaching a diameter of 0.3 mm. The hermaphroditic ampulla is very large, its average diameter being about 0.7 mm., with a total length of about 6 mm. It is coiled in an S-shaped loop upon the lower anterior face of the anterior genital mass (pl. xxi, fig. 112, *h. amp.*). At its anterior end it constricts suddenly, gives off the narrow spermatic duct and passes into the nidamental gland. The spermatic duct is very short, dilating into the large thick-walled prostata, which describes a U-shaped loop upon the upper anterior face of the anterior genital mass, immediately above the hermaphroditic ampulla, and resting upon and against the spermatotheca (pl. xxi, fig. 112, *pr.*). Its distal end constricts into the muscular vas deferens, which describes a downward loop, returns and passes outward to dilate gradually into the penis (pl. xxi, fig. 112, *v. d.*). The glans penis is cylindrical, blunt, about 3 mm. long by 0.04 mm. in diameter, is covered with a firm cuticle and with 5–6 rows of small recurved hooks (pl. xxi, fig. 114). These hooks average 0.003 mm. in height and 0.005 mm. in length.

The vagina is conical in form, its greatest diameter about 0.4 mm., its length 0.6 mm., and passes rather abruptly into the vaginal duct, a slender, thin-walled tube which courses straight inward to the spermatotheca, into which it opens very close to the exit of the uterine duct.

The spermatotheca is a large spherical thin-walled organ, having a diameter of about 2 mm., and making up fully one-third of the volume of the anterior genital mass (pl. xxi, fig. 112, *sp. th.*). Into the uterine duct, close to its origin, opens the narrow, slender duct of the spermatocyst, a rather large, elongated, pear-shaped organ lying upon the groove between the spermatotheca and the nidamental gland and overlapping both organs. Its distal end curves outward, is doubled downward upon itself and is continued into a short duct which opens into the uterine duct of the spermatotheca, close to the latter. The total length of the spermatocyst is about 2 mm., its greatest diameter being nearly 0.5 mm.

The nidamental and albumin glands make up about one-third the bulk of the anterior genital mass. The former is much the larger, contains a large cavity and partially incloses the albumin gland on its inner face. The duct of the nidamental gland (pl. xxi, figs. 112, *n. gl. d.*) lies below and slightly behind the vas deferens and vaginal duct, their external openings occupying a similar relation.

This species presents many marked differences from the only other recorded species of this genus, *A. zetlandica* Alder and Hancock, and is without question distinct from it. It is here provisionally identified with Cooper's *Doris sanguinea*, though it may prove to be different, if Cooper's original specimens can ever be found. It occurs all along the coast from Monterey Bay to Point Lobos in rocky tide pools and is not at all rare during the summer months.

A specimen deposited in the U. S. National Museum (no. 181277).

Subfamily VI. CADLININÆ.

Body somewhat depressed; notæum granuligerous, scarcely rough; branchial leaves simply pinnate, bi- or tripinnate; tentacles short, flattened, acuminate; foot rather wide, with a deep anterior marginal sulcus. Labial armature lamelliform, almost annulate, of extremely small hooks. Rhachis of radula with a denticulate tooth; pleurae multidentate, pleural teeth hooked, the external margin serrulate.

Genus 7. CADLINA Bergh.

Cadlina Bergh. On the Nudibr. Gasterop. Moll. of the North Pacific Ocean, I, Proc. Phila. Acad. Nat. Sci., 1879, p. 114. Die Opisthobranchien, Bull. Mus. Comp. Zool., XXV, 10, p. 168. System der Nudibr. Gasteropoden, 1892, p. 108. Malacol. Unters. XVIII, 1892, p. 1100.

Glans penis armed with a series of hooks.

7. **Cadlina marginata** MacFarland.

[Pl. xxv, figs. 10–12; pl. xviii, figs. 27–31.]

Cadlina marginata MacFarland, op. cit., p. 43

Body elongate, elliptical, somewhat depressed, less abruptly rounded behind than in front. Notæum firm, covered everywhere with low tubercles, each one tipped with lemon yellow surrounded by a narrow ring of white and forming the center of a clearly marked polygonal area (pl. xxv, fig. 11). General ground color everywhere clear translucent yellowish white, the tubercles tipped as above. Upper and lower margins of mantle, and lateral and posterior edges of foot with a narrow band of lemon yellow (pl. xxv, figs. 10, 12), the tips of rhinophores and branchiae and their sheaths of the same color. In alcohol the light yellow color disappears and the animal becomes uniformly white. Varying degrees of contraction of the notæum in death cause the mantle tubercles to become more or less prominent within a wide range.

Mantle margin wide, broadly overlapping the foot everywhere except posteriorly (pl. xxv, fig. 10.) Foot narrow, nearly linear, tapering slightly posteriorly, in front abruptly rounded, bilabiate, the upper lip notched, thin, the lower one thick and fleshy. General ventral surface everywhere smooth and white, except the yellow border of foot and mantle.

Head small, rounded, mouth a longitudinal slit, the tentacles short, triangular, flattened, auriform, with a distinct external groove.

Rhinophores small, perfoliate with 16–18 leaves, the clavus conical, inclined backward, the cylindro-conical stalk erect, the whole organ completely retractile within a low sheath, the margin of which bears low tubercules tipped with lemon yellow.

Branchial plumes 6, bipinnate, spreading, arranged in an incomplete circle which is completed behind by the anal papilla. The plumes completely retractile within a low sheath with tuberculate margin, the tubercles tipped with lemon yellow.

Dimensions of large individual: length 45 mm., width 22 mm., and height 8–10 mm.

Pharyngeal tube cylindro-conical, 2.5 mm. long by 2 mm. wide, the pharyngeal bulb strong, 4 mm. long by 2.5 mm. wide by 3 mm. high, cylindro-conical, the radula sac projecting behind and below as a cylindrical, rounded prominence for about 1 mm. Labial disc convex, the opening triangular with the apex downward, the armature a broad yellow band, quadrangular below, narrowing on the sides and interrupted above, its greatest width 1 mm. The elements of the armature are closely set bifid hooks about 0.04 mm. in height (pl. xviii, fig. 27.)

The broad radula has a length of 4 mm. and a width of 2 mm., with a shallow median groove. The teeth are in 90 rows, of which the last 4 are undeveloped in the sheath. The dental formula is 47–1–47. Rhachis with a single series of teeth, erect, hooked, the tip divided into 4–6 nearly equal blunt denticles (pl. xviii, fig. 28*a*.)

Pleural teeth 47, the first one strongly hooked with 3 large denticles on its inner margin (pl. xviii, fig. 28*b*), and 6–7 smaller ones on the outer margin. The successive pleuræ are of much the same shape, the tip becoming longer and more pointed, the denticles limited to the outer margin alone and increasing in number to 12 (pl. xviii, fig. 29). The outermost pleuræ diminish in size, being finally reduced to compressed, jagged, slightly concave plates (pl. xviii, figs. 30–31).

The liver is smooth, plump, bluntly conical in outline, the apex directed backward and lying just beneath the branchial rosette. Anterior end obliquely truncate toward the left side from about the middle of the organ. Length 17 mm., breadth 8 mm., and height 6 mm. in an individual of 35 mm. total length.

The hermaphrodite gland, yellowish in color, is distributed in thin lobules over the surface of the anterior and lateral portions of the liver, extending well backward toward its tip. The hermaphrodite duct is formed by the union of 2 ducts meeting at right angles on the anterior oblique face of the liver, coming from the upper right and left hand lobules of the hermaphrodite gland, respectively. The main duct is quite short, dilating into the long ampulla, the posterior end of which describes a loop upon the anterior median face of the liver and, passing forward, is looped back and forth upon the lower inner and anterior faces of the anterior genital mass. Immediately after giving rise to the vas deferens it passes into the nidamental gland close to the anterior border of the albumin gland.

The anterior genital mass is oval in side view, somewhat wedge-shaped from above, the thin end directed posteriorly and formed by the nidamental gland. The external face is convex, the inner one flattened. The lower anterior border is occupied by the coils of the hermaphrodite ampulla, immediately above which lies the dark spermatotheca, and upon this in turn the thick loop of the prostatic portion of the vas deferens. Greatest antero-posterior length of inner face of the anterior genital mass is 10 mm., its height 7 mm.

The penis is short, about 2 mm. in length, passing over into the vas deferens, at first slender and muscular, but rapidly increasing in diameter and becoming glandular. It courses inward and backward upon the upper anterior face of the anterior genital mass, doubles downward upon itself and returns outward and downward to its origin from the anterior end of the hermaphroditic ampulla. Its greatest diameter is reached about midway of its length, where it measures 1.4 mm., with a total length of about 10 mm. The glans penis is short, bluntly conical, and armed with minute hooks.

The vagina is short and narrow, tapering into the straight vaginal duct which courses directly inward and upward to the spermatotheca, into which it opens. Close to its entrance is the opening of the uterine duct which receives the duct of the spermatocyst, about midway of its length toward the nidamental gland, into which it opens close to the opening of the hermaphroditic ampulla.

The spermatotheca is somewhat spherical in shape, dark brown, and is about 3.5 mm. in diameter. It lies upon the anterior inner face of the anterior genital mass between the loops of the prostate portion of the vas deferens above and those of the ampulla of the hermaphrodite duct below. The openings of the 2 ducts are very close together upon the outer face of the organ.

The spermatocyst is pear-shaped, 1.4 mm. long by 1 mm. broad, and lies below and behind the loop of the vas deferens, its narrower end directed outward and downward, the duct short and slender, joining the uterine duct about midway of the length of the latter. The uterine duct passes as usual into the nidamental gland close to the anterior border of the albumin gland.

Type no. 181287 U. S. National Museum.

8. Cadlina flavomaculata MacFarland.

[Pl. xxv, fig. 9; pl. xix, figs. 32–37; pl. xxi, fig. 110.]

Cadlina flavomaculata MacFarland, op. cit., p. 43.

Body elongate, elliptical, almost linear, depressed, bluntly rounded at the ends, less so behind than in front. Notæum thickly set everywhere with low rounded tubercules. General color yellowish white, inclined to cream, on each side of dorsum a row of 7–10 small lemon yellow spots borne upon low tubercules, the first one of these spots just outside of and behind the rhinophores, the last one outside of and usually behind the branchial plumes (pl. xxv, fig. 9).

Rhinophores black, brown or brownish yellow, very conspicuous against the pale dorsum. Branchial plumes white or yellowish white (pl. xxv, fig. 9). In alcohol the dark color of the rhinophores is usually permanent, the rows of lemon yellow tubercules become white and are usually easily distinguishable, while the general body color becomes paler or is lost entirely.

Mantle margin broad, thin, densely spiculate, everywhere widely overlapping the foot except behind, its under surface smooth (pl. xix, fig. 32).

Foot linear, bluntly pointed behind, in front abruptly rounded, bilabiate, the lower lip thick, fleshy, the upper one thinner. Head small, fitting into a depression in ventral surface of mantle, the tentacles short, flattened, blunt, auriform, with a distinct groove on outer margin (pl. xix, fig. 32).

Rhinophores rather large, erect, diverging, perfoliate with 10–12 leaves, the clavus forming three-fourths of the total length of the organ. Rhinophores deeply retractile within low sheaths, the margins of which are thin and slightly tubercular.

Branchial plumes small, 10–11, usually simply pinnate (pl. xxi, fig. 110), occasionally bipinnate in part, spreading, completely retractile within low sheath with thin edges.

Length of large specimen 20 mm., breadth 8–10 mm., and height 3–4 mm.

Labial disc strongly convex, the opening triangular with the apex directed upward. Labial armature a broad, light yellow band, quadrangular below, triangular on the sides, narrowing toward the top, where it is interrupted, the inner surface of the band everywhere convex. Greatest width 0.390 mm. The elements of the armature closely set, slightly curved hooks, bifid at the distal end, with a neight of about 24 mm. (pl. xix, fig. 33).

Radula small, broad, 1 mm. long by 0.6 mm. wide, with a very shallow median grove. Teeth in 77 rows, the last 4 immature. Dental formula 23–1–23. Rhachis very narrow, bearing a single series of teeth overlapped by the first pleural on either side (pl. xix, fig. 34). Base of rhachidian teeth large, the hook nearly horizontal, divided into 4–6 long, nearly equal blunt denticles (pl. xix, figs. 34–35). Pleural teeth 23 in number, the first lateral with a stout hook bearing on its inner margin 2–3 large denticles, on the outer margin 4–7 smaller ones (pl. xix, fig. 34). The successive lateral teeth beyond the first increase in height and in the number of denticles upon the outer margin up to 12–15, the inner margin being destitute of them. Toward the middle of the row the denticles become longer, more slender, and the whole tooth becomes saw-like in form (pl. xix, fig. 36). The outer 3 or 4 decrease in size somewhat (pl. xix, fig. 37*b*), but not so much as in the preceding species. Height of largest lateral teeth 0.054 mm., width of rhachidian tooth 0.012 mm., its length 0.018 mm.

The peritoneum is colorless and smooth, the blood gland lobulated and closely applied to the central nervous system, over which it lies. The liver is smooth, bluntly rounded behind beneath the branchial opening, slightly dilated about midway of its length and obliquely truncated in front from right to left, the face thus formed being in close contact with the anterior genital mass. Total length 6 mm., its greatest width 3 mm. Midway of the left side of the liver the pyloric end of the stomach is exposed, giving rise to the intestine, which arches across to just beyond the median line toward the right and then pursues an oblique course backward to the anus.

The hermaphrodite gland is thick and lobulated, covering incompletely the dorsal, lateral, and anterior faces of the liver. The hermaphrodite duct is very short, dilating into the ampulla, which, passing forward on the lower inner face of the anterior genital mass for about 3 mm., doubles back upon itself, describing a simple loop, and returns posteriorly to the anterior inner edge of the oblique face of the anterior genital mass. Here it gives rise to the spermatic duct and opens into the nidamental gland.

The anterior genital mass is large, bluntly conical in front, beveled from left to right behind, the flattened face thus formed fitting closely against the oblique anterior face of the liver. The outer surface is convex and made up almost entirely of the nidamental gland.

The spermatic duct, rising from the distal end of the hermaphroditic ampulla at the point where it enters the nidamental gland, is a very long, closely coiled tube lying upon the anterior end of the anterior genital mass. In it may be distinguished a proximal thicker glandular portion in a conspicuous loop upon the upper anterior face of the genital mass, and a more slender muscular portion, the vas deferens proper passing into the conical penis (preputium) after describing a double loop upon the anterior face of the genital mass. The glans penis is short, bluntly conical, and is armed with minute recurved hooks, the armature extending for a distance of 1 mm. along the lining of its canal.

The vagina is short, conical, passing over into the very slender vaginal duct which courses inward to the inner oblique face of the nidamental gland and passes into the small spherical spermatotheca, about 0.27 mm. in diameter. Close to its entrance arises the uterine duct, which receives the duct of the small pear-shaped spermatocyst and passes into the nidamental gland.

Habitat: Found in rocky tide pools all along the coast near Pacific Grove. Not rare. Found at all times of the year in small numbers. Type no. 181279 U. S. National Museum.

Cadlina flavomaculata may be readily recognized by its peculiar coloration, the rich brownish black rhinophores standing out strongly against the light yellowish white of the body. It is an extremely sluggish animal in confinement, scarcely moving from its place in the aquarium, even under the most favorable conditions.

The 2 new species of *Cadlina* here described may be easily distinguished in life from any other of the Monterey Dorididæ by their striking coloration. But 1 other species of this genus has been taken in the Pacific Ocean, *Cadlina pacifica* Bergh, from Alaska. The subjoined tabulation of the radulæ of the 3 Pacific, together with the European species, will aid in distinguishing them.

Radulæ of species of Cadlina.

Species.	Rows of teeth.	Formula.	Median tooth.	First pleural tooth.	Outer pleuræ.
C. repanda Alder & Hancock	51–70	29–30, 1, 29–30	3–4 denticles on each side of hook.	3–4 denticles on inner side; 7–9 denticles on outer side.	Up to 25 denticles on outer side.
C. pacifica Bergh	67–85	33, 1, 33	.....do	5–6 denticles on inside; 6–7 denticles on outside.	Up to 18–22 denticles.
C. marginata MacFarland	90	47, 1, 47	4–6 nearly equal denticles. No median hook.	3 denticles on inside; 6–7 on outside.	Up to 12.
C. flavomaculata MacFarland	77	23, 1, 23	.....do	2–3 denticles on inside; 4–7 on outside.	Up to 15.

Subfamily VII. KENTRODORIDINÆ.

Body rather soft, somewhat depressed, notæum very minutely granulated, pallial margin wide; tentacles conical; branchiæ tripinnate; foot rather wide, its anterior margin with a deep sulcus, the upper lip deeply emarginate. Labial armature none. Rhachis of radula naked, pleuræ multidentate, the teeth hooked. Penis armed with a stylet or unarmed; vestibular gland and dart present or not.

Subfamily VIII. PLATYDORIDINÆ.

Body coriaceous, rigid, flattened, fragile, its outline usually oval or rounded; notæum smooth or most minutely granulated, pallial margin wide; branchial opening usually few-lobed, stellate; tentacles finger-like; anterior margin of foot bilabiate, the upper lip deeply notched. Labial armature none. Rhachis of radula naked, pleuræ multidentate, the teeth hooked. Prostata large.

Subfamily IX. CHROMODORIDINÆ.

Body elongate, compressed, soft; brilliantly colored, often striped or spotted; notæum nearly always smooth; mantle margin broad in front and behind, the rest quite narrow; tentacles small, conical, often as if everted; branchial leaves usually simply pinnate. Labial armature strong, of very minute hooks. Rhachis of radula very narrow, often with minute compressed spurious teeth; pleuræ multidentate, teeth hooked, often with denticulate outer margin, the first one denticulate on both margins. No true stomach. Penis unarmed.

Genus 8. CHROMODORIS Alder and Hancock.

Chromodoris Alder and Hancock, Mon. Brit. Nudibr. Moll., Pt. VII, 1855, p. XVII.—Bergh, Neue Nacktschnecken der Südsee, III, Jour. Mus. Godeffroy, H. VIII., 1875, p. 72; H. XIV., 1878, p. 1. Unters. d. Ch. elegans u. villafranca. Mal. Blätter, XXV. 1878, p. 1. Neue Chromodoriden, Mal. Blätter N. F., I, p. 87. Mal. Unters., XI, 1877, p. 464; Sup. H. I, 1880, p. 14; II, 1881, p. 81; XV, 1884, p. 64; XVI, 2, p. 831; XVII, 1890, p. 929, 974. Beiträge z. Kennt. d. japan. Nudibr., II. Verh. d. k. k. zool.-bot. Ges. Wien, XXXI, 1881, p. 219. Report on the Nudibranchiata, Challenger Reports, X, 1884, p. 64. Rep. on the Nudibranchs, Bull. Mus. Comp. Zool. Harvard, XIX, 1890, p. 160. System, der Nudibr. Gasteropoden. 1892, p. 112. Ueber einige verkannte und neue Dorididen, Verh. d. k. k. zool.-bot. Gesellsch. Wien, XLIII, 1893, p. 415. Die Opisthobranchien, Bull. Mus. Comp. Zool., XXV, 10, 1894, p. 190. Nudibranches et Marsenia provenant des campagnes de la Princesse Alice, Res. Camp. Sci. Albert Ier de Monaco, XIV, 1899, p. 17.—v. Jhering. Beitr. z. Kenntniss d. Nudibr. d. Mittelmeres, Mal. Blätter, N.F. II., 1880, p. 1.

9. Chromodoris porteræ Cockerell.

[Pl. xxvi, figs. 13, 14.]

Chromodoris porteræ Cockerell, Three new species of Chromodoris, The Nautilus, XVI, 1902, 2, p. 19.—MacFarland, op. cit., p. 44.

In the summer of 1894 a single individual of *Chromodoris* was taken at Light-House Point, and the colored drawings of plate xxvi (figs. 13, 14) were made from it. The animal escaped down the overflow pipe of the aquarium soon after, and no specimens have since then been found in the vicinity of Monterey Bay. In 1901 Prof. T. D. A. Cockerell described the above species from La Jolla, Cal., where it appears to be quite common, as also at San Pedro. With his kind permission the following description (l. c.) and analytical table of species of *Chromodoris* found by him are here reproduced:

"Length about 11 mm., form of *C. universitatis*, but uniformly much smaller and quite different in markings. Deep ultramarine blue, including the whole of the foot; mantle with two rather broad longitudinal stripes of bright orange, not united posteriorly and ending anteriorly at the rhinophores, but anterior to the rhinophores is a transverse orange stripe; median stripe of *C. macfarlandi* represented by an inconspicuous, lighter-blue line; margins of mantle very narrowly pure white; foot wholly without marks, except that the hind end has a suffused whitish stripe. Rhinophores and branchiæ entirely retractile. Branchial plumes 11, in a circle, simply pinnate, entirely of the blue color of the mantle. After death a number of conical white papillæ (about 9 on each side) appear beneath the hind part of the mantle. After death the blue dissolves out and the body becomes a sort of pale greenish blue, with the dorsal stripe very white and the orange bands as in life.

"Habitat: In rocky pools at low tide, La Jolla, Cal., early in August, rather common. (Wilmatte Porter Cockerell.)"

Table of species of Chromodoris found at La Jolla.

A. General color a deep ultramarine blue, which after death dissolves out in formalin, or even in sea water.
  a. Small, about 11 mm. long, mantle with two orange stripes, foot without orange marks................*C. porteræ* Ckll.
  b. Larger, over 60 mm. long, mantle and foot with numerous orange spots..........................*C. universitatis* Ckll.
B. General color purple, very brilliant, the color not dissolving out after death in formalin or sea water.
  a. Mantle with a yellow margin and three longitudinal yellow stripes; end of foot with an orange stripe.
C. macfarlandi Ckll.

The specimen taken at Pacific Grove was 22 mm. in length, twice that of the La Jolla specimens, but in all other external features agrees with them.

From my own notes of 1894 I take the following description:

Body elongate, linear, depressed, mantle about equally rounded in front and behind, mantle margin rather narrow laterally and behind, in front broad; tail not covered by the mantle save in its anterior portion. General body-color deep ultramarine blue; mantle with 2 broad longitudinal stripes of orange, entirely or incompletely united behind the branchial plume, ending in front just outside the bases of the rhinophores; in front of rhinophores a transverse arc of orange as if a continuation of the lateral stripe; a median light blue line extending from between the rhinophores to the branchiæ; margin of mantle narrowly edged with white; foot of same ultramarine blue as rest of body with a suffused median stripe of lighter blue upon dorsal surface of tail. Rhinophores perfoliate with 12 to 14 leaves, clavus slightly darker blue than the body of the animal, retractile within low sheaths with smooth margins. Branchiæ 9 to 11, simply pinnate, slightly lighter in color than the mantle, completely retractile within low sheaths with smooth margins.

Length, 22 mm. Radula? Reproductive system?

The above, together with the colored figures of plate xxvi, will suffice for the ready recognition of this species in life. I hope to be able soon to add detailed anatomical observations upon this and the other species of Californian Chromodoridinæ, which may throw some light upon the specific distinctions existing between them. Up to the present time there have been listed the following species of this genus from the western coast of North and Central America:

(1) *Chromodoris dalli* Bergh, Puget Sound.
(2) *Chromodoris californiensis* Bergh, Santa Barbara Islands, San Diego, Monterey (Dall).
(3) *Chromodoris universitatis* Cockerell, San Pedro, La Jolla.
(4) *Chromodoris agassizii* Bergh, Panama.
(5) *Chromodoris porteræ* Cockerell, La Jolla.
(6) *Chromodoris macfarlandi* Cockerell, La Jolla, San Pedro.
(7) *Chromodoris aegialia* Bergh, Gulf of California.

Sir Charles Eliot (Cockerell and Eliot, Notes on a Collection of Californian Nudibranchs, Journal of Malacology, XII, 1905, p. 37), comes to the well-founded conclusion that *Ch. universitatis* Cockerell is identical with the previously-described *Ch. californiensis* Bergh. The latter species is stated by Dall to have been taken at Monterey. It must be of extremely rare occurrence, as I have never found it in twelve years' collecting at varying times of the year.

Subfamily X. MIAMIRINÆ.

Form of body oval, somewhat depressed but arched; notæum cancellate, pallial margin rather wide; tentacles small or absent; branchiæ usually tripinnate; foot not narrow. Labial armature made up of minute rods or hooks. Rhachis of radula not narrow, naked, or with spurious teeth; pleuræ multidentate. No true stomach. Penis unarmed.

Family B. DORIOPSIDIDÆ.

Body nearly always soft, its form almost exactly as in true Dorididæ. Oral aperture pore-like, tentacles very short, adnate, rhinophores and branchiæ as in true Dorididæ. Notæum smooth or tuberculate, pallial margin usually wide and undulating. Foot wide as in true (cryptobranchiate) Dorididæ.

Oral tube simple, not glandular. Pharyngeal bulb an elongated cylindrical sucking tube, destitute of mandibles and radula. The posterior end of the liver deeply divided.

Penis armed with a series of hooks.

Genus 9. DORIOPSIS Pease.

Doriopsis Pease, Proc. Zool. Soc., 1860, p. 32. Amer. Jour. Conch., VI, 1871, p. 299.—Bergh, Nacktschnecken der Südsee, III, Jour. Mus. Godeffroy, VIII, 1875, p. 82; XIV, 1878, p. 21. Malacol. Unters., X, 1876, p. 384; Sup. I, 1880, p. 9; XV, 1884, p. 693; XVI, 2, 1889, p. 842; XVII, 1890, p. 963. Doriopsen des atlant. Meeres., Jahrb. d. d. Mal. Ges., VI, 1879, p. 42. Doriopsen d. Mittelmeeres, Jahrb. d. d. Mal. Ges., VII, 1880, p. 297. Report on the Nudibr., Challenger Rep., X, 1884, p. 117. System der Nudibr. Gasteropoden, 1892, p. 126. Opisthobranches prov. d. Camp. du yacht l'Hirondelle, Res. Camp. Sci. Albert Ier de Monaco, Fasc., IV, 1892, p. 16.

Doridopsis Alder and Hancock, Trans. Zool. Soc., V, 1864, p. 124.—Hancock, Trans. Linn. Soc., XXV, 1865, p. 189.

Body soft, smooth above. Buccal ganglia situated at posterior end of pharyngeal bulb.

10. Doriopsis fulva MacFarland.

[Pl. XXII, fig. 3; pl. XIX, figs. 38–40.]

Doriopsis fulva MacFarland, op. cit., p. 45.

Body elongate, elliptical, the mantle equally rounded in front and behind, slightly depressed, soft, the dorsal surface with low papilla-like elevations, nearly all of which bear a small central white fleck. General color of animal a rich yellow (pl. XXII, fig. 3), the foot and under side of mantle margin slightly lighter in color, the rhinophores darker, the branchial plumes yellowish white. In alcohol the yellow color is lost, but the white often remains. Mantle margin thin, crenulate, wide, extending well beyond the foot, its ventral surface showing a fine reticulate system of whitish lines, the meshes coarser nearer the body and becoming smaller toward the edge.

Foot elongate, elliptical, the anterior and posterior ends nearly equally rounded, the tail projecting but slightly beyond the mantle behind, the anterior margin bilabiate, the upper lip with a deep median notch, the lower lip fleshy, the lateral edge of foot thin.

Sides of body between mantle and foot very low, the color a lighter yellow than that of notæum. Reproductive openings in usual position upon a prominent rounded papilla.

Mouth opening very small, pore-like, entirely concealed between mantle and foot. Tentacles very short, flattened, adnate to the under surface of mantle, close together and directed forward.

Rhinophores not large, cylindro-conical, carried inclined forward and outward, the clavus slightly dilated, conical, the tip blunt, perfoliate, with about 18–20 leaves, the stalk cylindrical, smooth, one-third the length of the whole organ. Rhinophores completely retractile within conspicuous sheaths, with smooth, thin margins. Length of clavus, 4 mm.; of whole rhinophore, 6–7 mm.; height of sheath, 7 mm.

Branchial plumes 5, tripinnate, arranged in a circle, widespreading, deeply retractile within a sheath with high, thin, flaring margin, its edge smooth, its outer surface with small tubercules similar to those of the dorsum. Height of sheath 2 mm., its diameter 6 mm. Anal papilla at right of center of circle of branchiæ, bluntly conical. Renal opening inconspicuous, at base and slightly in front of the anal papilla.

Dimensions of large individual, length 65 mm., breadth 30 mm., height 12–13 mm. Width of mantle margin 8 mm.

Internal anatomy: Notæum thick, somewhat leathery in consistency. Pseudo-peritoneum colorless. Blood gland pale yellow, flattened, about 5 mm. long by 3.5 mm. wide, its anterior border resting upon the central nervous system, its left border in contact with the loop of the enlongated pharyngeal bulb.

Buccal tube cylindrical, white, 3 mm. long, dilating posteriorly into a conical portion, 4 mm. long by 2.5 mm. broad at its posterior end. From the center of the enlarged invaginated posterior face a long slender tube, 35 mm. long by 1 mm. wide, describes a loop to the left, constricts suddenly to half its diameter and then dilates at the upper margin of the visceral mass into a short, thin-walled tube which loops forward and downward to pass into the cavity of the liver.

The visceral mass is grayish, cylindrical, about 18 mm. long by 9 mm. wide, its posterior end rounded and deeply grooved vertically for the retractor muscle of the branchiæ. The anterior end is obliquely truncated upward and backward from the left side, the surface thus formed being variously faceted by contact with the anterior genital mass, the upper surface with a deep longitudinal groove for the esophagus and intestine. The cavity of the liver is large, centrally placed, with various short cavernous ramifications opening into it, and functions as a gastric cavity.

Hermaphroditic gland thin, yellow, covering anterior end and upper anterior half of the liver.

The hermaphroditic duct is short, about 3 mm. in length, narrow, and leads directly from the anterior border of the visceral mass into its ampulla (pl. xix, fig. 38 *h. amp.*), a large, straight, yellowish, thin-walled tube lying along the inner border of the nidamental gland, 7 mm. long by 2 mm. broad, its anterior end recurved and narrowing into a delicate tube running outward along the superior face of the gland for about 2 mm., where it passes into its substance, giving off as it does so the spermatic branch. The spermatic duct (pl. xix, fig. 38 *sp. d.*) passes directly into the left anterior lobe of a large glandular mass of a brownish yellow color, which overlies nearly the whole of the genital mass (indicated in fig. 38 by the dotted line), its lumen large and irregular, receiving branches from the various lobules of the gland. From the antero-median portion of this prostate-like gland the vas deferens appears as a strong white tube, describes a loop forward and passes into the penis. Length of vas deferens about 4 mm., gradually dilating into the penis. The penis (præputium) is conical, thick, about 3 mm. in length, the everted glans thick, cylindro-conical, about 1 mm. long by 0.6 mm. in diameter, the tip blunt. The whole glans is thickly set with a series of strongly-curved hooks arranged in quincunx, about 36 μ in vertical height and extending down the vas deferens for about 180 μ (pl. xix, figs. 39–40).

The uterine duct is narrow, 2 mm. long, dilating as it nears the point of entrance of the duct of the spermatocyst and opens into the spermatotheca by a common tube with the vaginal duct (pl. xix, fig. 38*a*, *u. d.*). Spermatocyst (pl. xix, fig. 38 *sp. c.*) long, tubular, coiled upon itself at posterior inner margin of the anterior genital mass, about 6 mm. long by 1.25 mm. in diameter, its duct (pl. xix, fig. 38*a* *sp. c. d.*) long and narrow, running along the upper surface of the spermatotheca to its anterior side and opening into the uterine duct. Length of duct of spermatocyst 5 mm., its diameter 0.5 mm.

Spermatotheca (pl. xix, fig. 38 *sp. th.*) very large, spherical, forming fully one-half the bulk of the anterior genital mass, covered dorsally by the brownish gland of the vas deferens. From its anterior face the vaginal duct passes outward directly into the vagina without any sharp line of demarcation. Length of vaginal duct about 3 mm., its diameter 1 mm.; length of the vagina 3.5 mm., its diameter 2–2.5 mm.

Doriopsis fulva is perhaps the commonest nudibranch to be found at Pacific Grove, occurring in the tide pools all along the coast at all times of the year, but perhaps most abundantly during the summer months. Its egg bands are in the usual form of a long flat ribbon, about 7 mm. in width, closely coiled, yellow in color and fastened to the sloping sides of rocks or to brown algæ, and are also deposited abundantly in the aquarium, in which the animal may be readily kept. Egg-laying may occur at any time during the year, but takes place mainly in summer.

Type no. 181286 U. S. National Museum.

Family C. PHYLLIDIADÆ.

Body subcoriaceous, oval or elongate-oval, subdepressed. Head indistinct, oral aperture porelike, tentacles short, connate at the base, forming a very short veil above the oral aperture, sulcate, digitiform or depressed, free, rarely (*Phyllidiopsis*) affixed; rhinophores retractile into sheaths, the clavus perfoliate. Ends of body almost equally rounded. Notaeum dilated in its whole circumference, the pallial margin everywhere extending beyond the foot. Back almost always uneven, tuberculate; the tubercules forming mid-dorsal longitudinal series or arranged in quincunx; the halo of the anterior tubercules of the lateral series perforated by the rhinophores or contiguous to them; the halo of the posterior median series (genus *Fryeria* excepted) perforated by the anus or contiguous to it. * * * External portion of the under side of mantle margin smooth, the inner portion bearing thin transverse branchial lamellæ, interrupted in front by the depression for the head, on the right side by the genital papilla. Anal aperture postero-median upon the dorsum or, rarely (*Fryeria*), between mantle and foot, the cylindrical rectal tube projecting from its cavity, a groove on its right side leading below to the renal pore. Sides of body low, the foot well developed, narrower, and shorter than the mantle.

Oral tube large, suctorial, pyriform, symmetrical (usually), or asymmetrical on account of a regular or irregular glandular mass covering it; behind continued into the long, cylindrical pharyngeal bulb, destitute of mandibles and radula. Posterior end of liver not cleft. Penis armed with a series of hooks.

Family D. POLYCERIDÆ.

Branchiæ of pinnate plumes arranged in an arc or circle, united or separate at their bases, never retractile into a cavity. Clavus of rhinophores usually perfoliate. Pharyngeal bulb sometimes with a sucking crop.

Subfamily XI. POLYCERIINÆ.

Body more or less elongate and limaciform; dorsum scarcely set off from the sides, or with a prominent lateral margin; frontal limb more or less prominent, simple or ornamented with simple or composite appendages; on each side of the dorsum often either a single dorsal appendage (branchial) or several simple or composite ones in a series along the margin. Rhinophores with or without sheaths, the clavus usually perfoliate. Branchiæ of few plumes, the plumes often composite. Tentacles small, lobelike, foldlike, or auriculate. Foot not wide, usually rounded in front. Pharyngeal bulb simple. Buccal cavity usually armed with mandibular laminæ (often made up of minute rods). Rhachis of radula usually naked; the larger lateral teeth uncinate, the external ones simple, usually without hooks. Glans penis armed with a series of hooks.

Genus 10. ÆGIRES Lovén.

Ægires Lovén, Öfvers. Vetensk.-Akademiens Förh., I, 1845, p. 49. Ind. moll., 1846, p. 6.

Ægirus Lovén, Alder and Hancock, Monogr. part IV, 1848, fam. 1, pl. 21; part VI, fam. 1, pl. 17, figs. 13-15; part VII, 1855, p. 44, XIX, pl. 46 sup., fig. 17.—G. O. Sars, Moll. reg. arct. Norv., 1878, tab. XIV, fig. 10ab.

Ægires, Bergh, Beitr. z. Kenntniss der Polyceraden. II, 1880, Verh. d. k. k. zool.-bot. Ges. Wien, XXX, p. 649. System der Nudibr. Gasteropoden, 1892, p. 146.

Body somewhat limaciform, robust, rigid, with numerous tubercules above, mostly in rows; frontal margin narrow, tuberculate; pallial margin inconspicuous, tuberculate; clavus of rhinophores simple, their sheaths oblique; tentacles small, lobiform; branchiæ of few tripinnate leaves, each one protected by a peculiar individual lobe.

Labial disc with a band of minute rods close to the buccal aperture below; a large mandible present above. Radula moderately wide; the rhachis naked; pleuræ with many uniformly hooked teeth. Glans penis armed.

11. **Ægires albopunctatus** MacFarland.

[Pl. XIX, figs. 41–44.]

Ægires albopunctatus MacFarland, op. cit., p. 45.

Body arched, not at all depressed, robust, highest and broadest immediately in front of the branchial plumes and sloping rapidly behind into the broad, bluntly rounded tail, in front more gradually. Dorsum thickly set everywhere with short, blunt tubercules, cylindrical or with slightly expanded apices, arranged in irregular rows. Frontal margin narrow, closely set with tubercules, continued behind the rhinophores as a tuberculate ridge, becoming less and less prominent until the dorso-lateral margin is at length marked only by an irregular row of tubercules, curving upward and meeting the median dorsal row of the tail behind the branchiæ.

Foot narrow, linear, the sides nearly parallel, tapering abruptly behind into the bluntly rounded tail, in front truncate, undivided, the angles simply rounded.

Mouth small, inconspicuous, with a small, lobelike tentacle on each side.

Sides of body set off sharply from margin of foot, smooth below and in front, behind and above with three unequal rows of tubercules diverging slightly posteriorly.

Ground color white or yellowish-white with irregularly scattered small, dark-brown spots, or entirely white. Margin of dorsum and everywhere between the tubercules sprinkled with minute dots of pure white.

Rhinophores simple, cylindrical, truncate, 0.5 mm. long, completely retractile within prominent tuberculate sheaths, the 5–6 tubercules and the margin being high on the outer side and quite low on the inner one. Between the rhinophores a median longitudinal row of tubercules becoming irregular behind.

Branchial plumes 3, tripinnate, small, each one protected by a large irregularly tuberculate lobe at its outer side.

Length of large individual 13 mm., width 3.5 mm., height 4 mm.

Pharyngeal bulb short, strong, nearly spherical in shape, about 2 mm. long, slightly less in height and width, the radula sac projecting behind and below for 0.5 mm. The labial disc is convex, the opening triangular, clothed with rather thick cuticula. Above, forming the roof of the opening, is a single, broad, thick mandibular plate, a narrow girdle of fine rodlike cuticular thickenings guarding the opening. The mandibular plate (pl. XIX, fig. 41) is quadrangular in form, its anterior cutting edge very thick, straight, the posterior one much thinner, rounded and colorless. Width of mandible 345 μ.

Radula broad, deeply grooved, colorless, except in the posterior rows, which are yellowish. Teeth in 16–22 rows, the last two immature, the formula of the dentition 17–0–17. Rhachis narrow, naked. Pleural teeth 17, similar in form, strongly hooked. Shaft with the usual thin, winglike process on the inner margin, as shown in plate XIX, figure 44, which represents the fifth and sixth pleuræ of the sixth row. The innermost tooth is the smallest of the pleuræ, the succeeding four increasing in size pl. XIX, fig. 42), the remaining ones nearly equal, the outermost one slightly smaller (pl. XIX, fig. 43). Length of innermost tooth 0.09 mm., the outermost about 0.09 mm., average length of teeth from middle portion of row 0.108 mm.

The anterior genital mass is plano-convex, the plane surface directed upward and inward, elliptical, about 4 mm. long by 2 mm. broad. The spermatotheca is spherical, 1.2 mm. in diameter, and lies upon the anterior upper border of the genital mass. Opening into it close together are the vaginal duct and the oviduct, the former passing straight outward to the vagina, the latter short, receiving the duct of the small pear-shaped spermatocyst and uniting with the hermaphroditic ampulla.

The penis (præputium) is 0.450 mm. long by 0.210 mm. in diameter and passes gradually over into the slender vas deferens. The retracted glans is cylindrical, short, bluntly rounded at the end, 0.372 mm. long, its canal clothed with very minute, densely set hooks for 0.108 mm. of its length from the tip.

Habitat: Under overhanging rocks at low tide all along the coast from Monterey to Point Lobos. Not rare. Especially common upon sponges in a tunnel-like grotto formed by the waves near Pebble Beach, on Carmelo Bay. Very sluggish in movement, shuns the light, and soon dies in captivity.

Type no. 181282, U. S. National Museum.

Genus 11. LAILA MacFarland.

[Pl. xxvii, fig. 15; pl. xix, figs. 45-50.]

Laila MacFarland, op. cit., p. 46.

Body depressed; frontal and lateral margins narrow, set with club-shaped papillæ; rhinophores retractile, clavus perfoliate; branchial plumes few, tripinnate, nonretractile into a sheath; tentacles blunt, canaliculate. A flattened submarginal ridge on each side of the anterior end of the body just behind and above the tentacles.

No labial armature nor mandibles. Radula not narrow, the rhachis with a single series of flattened spurious teeth; first pleural tooth slender, hook-like, the second large, the remaining lateral teeth (10-13) smaller, flattened.

Glans penis armed.

This genus was proposed for the reception of the following form. It is allied to the genera *Triopa* Johnston and *Issa* Bergh, but differs from the first in the character of the frontal appendages and in the presence of spurious teeth on the rhachis of the radula. From *Issa* it differs in the absence of mandibles, and from both in the presence of the submarginal flattened ridge or lobe.

12. Laila cockerelli MacFarland.

[Pl. xxvii, figs. 15; pl. xix, figs. 45-50.]

Laila cockerelli MacFarland, op. cit., p. 47.

Body elongate, depressed, the ends rounded, the back slightly convex, the mantle margin prominent, overlapping the foot everywhere except behind.

Dorsum rounded (pl. xxvii, fig. 15), gently sloping to sides and anterior and posterior ends from region of the heart. Pallial margin bearing closely set, stout, club-shaped papillæ arranged in short oblique rows of 3-4 papillæ in each, increasing progressively in size from the outermost ones toward the median line. Length of papillæ 1-6 mm., breadth up to 1 mm. Each papilla is supported by an axial column of strong spicules. Median portion of dorsum with numerous scattered low tubercules of varying size, the largest near the median line, between them the surface smooth.

Head wide (pl. xix, fig. 45), sloping above, the frontal margin prominent, bearing papillæ similar to those of the sides of the mantle, the mouth opening large with conspicuous fleshy, plicated lips. Along the side of the head and anterior end of the body on each side a fleshy, flap-like subpallial ridge (pl. xix, fig. 45*a*), its anterior end just behind and slightly above the base of the oral tentacles, close below the pallial margin and parallel to it. The anterior and posterior ends of the ridge are rounded, its margin smooth. Length of ridge 2 mm., width 0.5 mm. Tentacles cylindro-conical, truncate, grooved on upper surface throughout the entire length. Length about 2 mm., diameter at base 0.7 mm., at apex 0.3 mm.

Foot linear, abruptly pointed behind and extending beyond the mantle, its margins thin and broad, in front squarish, slightly emarginate, the corners rounded, deeply bilabiate, the upper lip projecting beyond the lower and slightly concave (pl. xix, fig. 45.)

Rhinophores retractile within smooth margined sheaths. Stalk and clavus of nearly equal length, tapering to a blunted apex, the clavus slightly dilated, perfoliate with about 13 leaves.

Branchial plumes 5, nonretractile into cavity, tripinnate, in an incomplete circle the center of which is occupied by the anal papilla. Renal opening at right of anal papilla and near its base.

General color yellowish white, slightly translucent. Clavus of rhinophores, processes of pallial margin, and tail tipped with deep orange red, the branchial plumes and dorsal tubercules occasionally flecked with the same color. Dorsum marked with irregular network of transparent lines upon the whitish background, the effect of the multitudinous spicules shining through the skin.

Total length 20 mm., width 7 mm., height 6 mm. in the largest individual taken.

Pharyngeal bulb small, flattened, oval in shape, the radula sheath projecting slightly behind. Length 3 mm., width 2 mm., height 1 mm., in an individual of 15 mm. length. Lip disk directed obliquely downward, strongly convex, covered by thin colorless cuticula, the opening vertical, slit-like, with a slight T-shaped widening at dorsal and ventral margins, formed by shallow grooves at either side. A slight ring-like thickening of the cuticle marks the opening; behind this the cuticle has a faint tesselated appearance. No distinct mandibular plate present.

Radula nearly colorless, broad, with wide median groove. Teeth in 76–82 rows, the last 2 or 3 rows incompletely developed. Rhachis narrow, averaging 19 μ wide, with a single series of colorless flattened plates occupying nearly the whole width of the rhachis, nearly rectangular in form, slightly broader at anterior than at posterior end, the edges irregular in outline. Average length 0.018 mm., width anterior end 0.011 mm., posterior end 0.008 mm. (Pl. XIX, figs. 46, 48). Pleural teeth 2, the first one (pl. XIX, figs. 46, 47*a*) a simple, strongly curved hook directed vertically, its shaft somewhat expanded and flattened at its posterior end and fitting closely to the second pleural tooth. Length 0.036 mm. The second pleural tooth (pl. XIX, fig. 47*b*) strong and heavy, the shaft irregular in form, oblique, at its upper end two strongly hooked cusps, the inner one smaller and directed inward, the larger outer one being more vertical, the two together forming a crescentic figure as seen from above. Below the inner hook a strong rounded elevation on the upper portion of the shaft, passing obliquely outward into a ridge. The lower end of shaft bluntly rounded, bearing a slight wing-like elevation on its outer face. Length of lateral tooth from end of shaft to crest 0.038 mm., diameter below inner cusp 0.011 mm.

Uncinal teeth 10–13 in number, closely set, pavement-like, presenting from above an arched, quadrangular outline with two pointed cusps at the lower angles strongly developed in the first 4 teeth (pl. XIX, fig. 46 *c*, *d*; fig. 49 *e*, *f*), but much reduced and finally disappearing in the remaining outer ones (fig. 49 *g–n*), which become modified into flattened plates of considerable thickness.

Glans penis long, cylindrical, blunt, about 0.6 mm. in length by 0.04 mm. in diameter, with an armature of minute thorn-like hooks arranged in 10 to 12 slightly irregular longitudinal rows (pl. XIX, fig. 50.)

Habitat: Under shelving rocks in tide pools along the coast, especially near Point Aulon and Point Pinos. Not rare. Much smaller individuals of the same species have been collected at San Pedro, Cal., by Prof. T. D. A. Cockerell, who has very kindly turned some of them over to me, together with his notes upon the same. I take pleasure in dedicating this species to him.

Type no. 181290, U. S. National Museum.

Genus 12. TRIOPHA Bergh.

Triopha Bergh, On the Nudibranchiate Gasteropod Mollusca of the North Pacific Ocean (Dall, Explor. of Alaska, I, Art. 6), II, 1880, pp. 261–266, (also in Proc. Acad. Sci. Phila., 1880, p. 112). System der Nudibr. Gasteropoden, 1892, p. 148. Die Opisthobranchien, Bull. Mus. Comp. Zool., XXV, 10, 1894, pp. 184–187.

Form of body somewhat limaciform; margin of the narrow frontal lobe with a series of short simple or composite granulose appendages; margin of dorsum with nodulate or short-branched appendages; rhinophores retractile, clavus perfoliate; tentacles short, calyciform, the outer margin in part cleft (auriform); branchiæ of few tripinnate leaves.

Mandibular plates triangular, made up of short, closely set rodlets. Radula rather narrow; rhachis with several series (4) of spurious teeth; pleuræ with several (3–18) rows of larger teeth; lateral teeth many (10–18).

Prostate gland large. Glans penis armed.

This genus was established in 1880 by Bergh to receive two species of nudibranchs from the Pacific Ocean. Of these the *Tr. carpenteri* (Stearns) occurs in Monterey Bay and is here given, while the two following species are new but undoubtedly belong to this genus.

13. Triopha carpenteri (Stearns).

[Pl. XXVII, figs. 16, 17; pl. XIX, figs. 51–55; pl. XXI, figs. 108, 113.]

Triopa carpenteri Stearns, Description of a new genus and two new species of nudibranchiate mollusks from the coast of California, Proc. Cal. Acad. Sci., V, April 21, 1873, p. 78, fig. 2.—MacFarland, op. cit., p. 48.

Body limaciform, elongate, robust; anteriorly obtusely rounded, posteriorly rather bluntly pointed. Head obliquely flattened, semilunar, bearing a narrow frontal margin (pl. XXI, fig. 108) extending laterally beyond the rhinophores, continued behind into the less conspicuous dorso-lateral ridge, and bearing along its whole length a large number of irregularly lobed and tuberculate papillæ (pl. XXVII, figs. 16–17). Dorsum slightly arched, set off from the sides by a series of tuberculate processes (5–9), of varying size and form, borne upon an inconspicuous low ridge, in many cases almost indistinguishable. The first of these processes lies in continuation with the frontal margin in the region of the rhinophore, the last 2 or 3 behind the branchiæ. Scattered upon the minutely granuligerous dorsum many smaller simple or compound tubercles, in some cases approximating the size and complexity of the marginal ones. These are usually irregularly arranged, tending, however, in some individuals to form a median series, especially in the head region (pl. XXVII, fig. 16). Behind the branchiæ a median tubercle, often several scattered ones, and in front of the rhinophores 2 or 3 similar ones.

Rhinophores retractile into prominent sheaths, the margins of which are thin, smooth, or slightly wavy in outline. Stalk stout, erect; the clavus curved backward and upward, perfoliate with 20–30 leaves.

Branchiæ 5, large, tripinnate, wide spreading, entirely separate at the base; 1 anterior median plume and 2 pairs of lateral ones. In the center of this circle of branchiæ is the anal papilla, a conspicuous conical elevation bearing the anal opening at its summit. Near its base on the right side is the minute renal pore.

Tentacles short and stout, auriform, a longitudinal slit extending along their outer border, the margins of which fold together (pl. XXI, fig. 108, *a*). In alcoholic material these organs often take on a cuplike form, due to shrinkage.

Anterior margin of foot rounded, the sides nearly parallel, the posterior end rather abruptly pointed.

General body color white (pl. XXVII, figs. 16, 17), inclined to yellowish above, often sprinkled with minute white spots borne upon very small tubercles. Tips of branchiæ, clavus of rhinophores, appendages of frontal and lateral margins, and the numerous scattered tubercles of the dorsum a deep orange color. Numerous irregular blotches of orange are also scattered along the sides of the animal in no regular arrangement. The region of the body beneath the gill plumes is darker, caused by the deep brown liver shining through the skin. In alcoholic specimens the orange color is lost and the specimens are everywhere white.

Pharyngeal apparatus large and strong, in shape truncately conical, slightly compressed laterally, the radula sheath projecting below and behind as a rounded eminence.

Lip disk strongly convex, covered by a strong, brownish yellow cuticula, the opening inverted T-shape (pl. XIX, fig. 55). Behind the oral slit on each side the cuticula passes into a triangular, brownish yellow plate, broad above, its apex directed downward. In an individual of 5 cm. length this plate has an extreme length of 2 mm. and a height of 3 mm. and is made up of closely set slightly curved blunt rods, those of the anterior border having a length of about 0.150 mm. and a diameter of 0.004 mm.

Radula broad, deeply grooved, dark amber in color. Teeth in 33 rows, of which 3 are immature at the end of the sheath. Rhachis broad, bearing 4 rows of flattened plates (spurious teeth). The inner 2 rows of these plates, in the older portion of the radula, are quadrangular, about 180μ in width by the same in length, grayish yellow, the anterior margin thickened and smooth, the lateral and posterior ones irregular (pl. XIX, fig. 51). In the younger, posterior portion of the radula these plates become lighter in color, trapezoidal in shape, and much wider than long (pl. XIX, fig. 54); e. g., in the thirtieth row, length of plate 0.150 mm., width of posterior margin 0.240 mm., of anterior margin 0.165 mm. The outer row of median plates is made up of more triangular thickenings, the rounded and slightly thickened anterior margin being much narrower than the posterior one, the outer margin prolonged backward, especially in the posterior portion of the radula (fig. 54), where it becomes a long process extending under the pleuræ. Pleural teeth yellow, strongly hooked, of nearly uniform shape and size. The number varies in different individuals from 9 to 18. In five different radulæ the number of pleural teeth was 13, 18, 10, 9, 14, though for each radula the number is constant in all the rows. The base of each hook bears a wing-like process usually directed at right angles to the direction of the hook, and hence easily overlooked (fig. 53). The uncini (fig. 51), quadrilateral in general outline, vary from 9 to 18 in number in different radulæ, while in the same radula the number is not a constant one for all of the rows. A conspicuous longitudinal crest directed toward the median line is borne by most of the uncini. It gradually decreases in size toward the outer portion of the radula and is entirely lacking in the outermost three or four uncini (pl. XIX, figs. 51, 52).

The esophagus is a nearly straight muscular tube passing almost directly backward from the pharyngeal bulb, 10 mm. in length and reaching a diameter of 3 mm. At the anterior border of the visceral mass it dilates into the stomach, which lies in a deep, oblique groove in the anterior end of the liver. The stomach describes a simple loop from right to left, its pyloric portion, emerging from the liver on the lower left-hand side, curving upward and forward upon the upper face of the liver, thence in a broad loop backward to the anus. Total length of the intestine about 23 mm. The liver is bluntly conical behind, its surface smooth, the anterior end bluntly flattened. The oblique groove in which the stomach is included divides it almost completely into two unequal lobes.

The hermaphroditic gland covers nearly the whole surface of the liver with its rather thick lobules. The hermaphroditic duct is very long and slender, and, arising from the anterior dorsal side of the groove in the liver, courses forward and downward to the posterior face of the anterior genital mass, where it describes a series of irregular loops between the spermatotheca on the left and the nidamental and albumin glands on the right, this portion being slightly more dilated than the first part of the hermaphroditic duct, thus forming the hermaphroditic ampulla. At the anterior end of the nidamental gland the ampulla constricts again, gives off the spermatic duct, and passes into the nidamental gland. The spermatic duct dilates almost at once into the long, thick, lobulated prostate gland, about 14 mm. in length by 2 mm. in breadth, which describes a loop (pl. XXI, fig. 113, *pr.*) upon the anterior face of the anterior genital mass, the distal end of the loop being again bent upward upon itself. A convoluted vas deferens succeeds the prostate for about 4.5 mm., dilating at the upper anterior surface of the anterior genital mass into the obliquely placed cylindrical ampulla, 4.5 mm. long by 2 mm. in diameter, its distal end directed toward the median line of the animal and doubling sharply outward toward the penis, into which it dilates. Glans penis and distal portion of lining of its lumen armed with minute hooks.

The vagina, 4 mm. in length by 1 mm. in extreme diameter, passes straight inward into the short vaginal duct, which opens through the outer anterior wall of the large spherical spermatotheca. The latter organ (pl. XXI, fig. 113, *sp. th.*) is about 5 mm. in diameter and makes up about one-half the bulk of the anterior of the genital mass. From its anterior face is given off the uterine duct close to the entrance of the vaginal duct. After a short course this duct passes, as usual, into the nidamental gland at its anterior inner face, receiving midway of its length the very short and slender duct of the spermatocyst. The spermatocyst (fig. 113, *sp. c.*) is pear-shaped, 2 mm. long by 0.7 mm. in greatest diameter, and is placed transversely upon the upper anterior portion of the nidamental gland in contact with and partly covered by the proximal end of the prostate gland.

Dimensions of largest preserved specimen, scarcely at all shrunken: Length, 60 mm.; height, immediately in front of branchiæ, 29 mm.; greatest width, 15 mm.; width of head, 15 mm.; maximum height of dorso-lateral processes, 3 mm.; length of foot, 57 mm.; its greatest breadth, 7 mm.

Habitat: On brown kelp of the fucoid zone and under overhanging rocks in tide pools everywhere along the rocky coast from Monterey to Point Lobos. Altogether the most common nudibranch of the region and the most conspicuous one, owing to the contrast of the bright orange color of its appendages with the white of the body. It is avoided by the tide-pool fishes as apparently inedible, its bright colors seemingly serving a warning purpose.

A specimen deposited in U. S. National Museum (no. 181291).

The fragmentary description of Stearns (1873)[a] is based entirely upon external features, but is sufficient to render certain the identification of living specimens. The foregoing brief anatomical description, especially the structure of the radula, shows that this is a species distinct from *Triopha modesta* Bergh, with which it has been united by the latter writer (Bergh, 1894, l. c.).

14. **Triopha maculata** MacFarland.

[Pl. XXVIII, fig. 18; pl. XIX, figs. 55a–59; pl. XXI, figs. 106, 107.]

Triopha maculata MacFarland, op. cit., p. 49.

Body limaciform, strongly rounded above, plump, the back passing over insensibly into the sides save for the line of processes which indicate the boundary. Sides slightly compressed, a shallow longitudinal groove immediately above the margin of the foot. Foot linear, bluntly rounded in front, less so behind. Head flattened in front, sloping forward from the rhinophores to the wide semicircular frontal margin, which bears a fringe of from 10 to 12 short, stout processes, each of which toward its distal end branches into several blunt or knoblike divisions, which may in turn be branched or knobbed (pl. xxviii, fig. 18). This frontal margin extends laterally below the rhinophores and in its prolongation along the dorso-lateral margin is a series of 4 to 6 short, branched processes essentially similar to those of the frontal margin. Posterior portion of the body sloping rapidly downward from a point just in front of the branchiæ into the short, blunt tail, which is highly arched above.

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[a] "Animal slug-shaped; anteriorly obtusely rounded, posteriorly pointed, somewhat attenuated; cephalic tentacles clavate, upper part of same of an orange color, below white; gill plumes 5, arborescent, resembling fern leaves, tipped with orange; plumes and tentacles $\frac{1}{16}$ inch in length; the former situated in the middle of the back somewhat posterior to the center. Six tentacular processes on each side, tipped with orange and $\frac{1}{16}$ inch long; also short tentacular processes in front of the head; body 1¼ inches in length, translucent white, covered with fine papillæ of an orange color. Habitat: Monterey, at Point Pinos, near the light-house, on the under side of granite rocks at edge of laminarian zone."

Rhinophores stout, club-shaped, rising from a conical base and expanding above into a broader clavus, directed backward and in turn tapering to a blunt tip. Length of clavus the same as that of the stalk, or nearly so, about 3 mm. Clavus perfoliate with about 18 plates, which are habitually carried in a nearly vertical position. Rhinophores retractile into conical sheaths about one-third the height of the whole rhinophore. Margin of sheath smooth or slightly crenulate, fluted longitudinally.

Below the broad semilunar frontal margin (pl. xxi, fig. 106) the rounded, full-lipped mouth, sucker-like in general appearance, at each side continuous with the oral tentacles. Oral tentacles auriform, directed forward and outward, the base cylindrical, outer half deeply grooved on upper side and transformed into a rolled plate, truncate at top with a wavy, sinuous margin (pl. xxi, fig. 107). Greatest diameter of tentacles equal to one-half their total length.

Branchiæ on posterior dorsum arranged in a circle about the anus in 5 tripinnate divisions arising from separate bases. Anterior plume unpaired in median line, the remaining 4 paired and laterally placed. Plumes low, wide spreading, nonretractile.

Anal opening at summit of conspicuous cylindrical papilla in the center of the circle of branchiæ.

Renal opening an inconspicuous slit on the base of the anal papilla on its right anterior side.

Color of dorsum and sides yellowish brown, usually of very deep shade, but in some individuals quite light. Dorsum and sides of body everywhere thickly set with small bluish-white round or oval spots, each one forming the center of a very slight polygonal eminence bounded by narrow orange-yellow lines upon the dark-brown background (pl. xxviii, fig. 18). Foot below orange yellow with fine dark-brown flecks save at the margins, which are clear deep orange, shading off above on the sides into the deep yellowish brown of the dorsum. In smaller individuals the general colors are usually lighter, tending to a light orange, the lighter bluish-white spots being smaller and less conspicuous. Frontal and dorso-lateral processes and tips of branchial plumes bright orange or vermilion, shading below into dark brown. Stalk of rhinophore yellowish, leaves and antero-median line of clavus and margin of the sheath edged with bright orange red.

Pharyngeal bulb very large and strong, conical, slightly compressed laterally, the radula sheath projecting behind and below as a rounded eminence. Length 4 mm., width 2.5 mm., height 2 mm. in an individual of 15 mm. total length.

Labial disk oblique, oval, somewhat convex, the opening of an inverted T or Y shape (pl. xix, fig. 59). Cuticula not thick, colorless, prolonged inward to form the tubular mouth lining, its sides continuous with the dark yellow, triangular mandibular plates characteristic of the genus. These plates are broadest above, the apex directed ventrally, and the anterior and dorsal margins are of nearly equal length, forming a right angle at their junction. The plates are made up of short, flexible, blunt, cross-striated rodlets having a diameter of about 3 μ.

Radula broad and short, deeply grooved, light yellow in color, and made up of about 14 rows of teeth. Rhachis broad, bearing 4 series of flattened plates (spurious teeth). The 2 innermost rows are quadrangular in shape, colorless, the anterior margin thickened and fairly smooth, the posterior one jagged and irregular (pl. xix, fig. 57, *a*). These plates increase in length from the anterior (older) end of the radula backward, and also, though less, in width, the general quadrangular shape remaining the same. The outer rows of rhachidian plates are made up of flattened triangular elements, slightly larger toward the sheath than in front. They are about as long as broad and bear a more or less extensive thickening in the central region, the lower inner corner of which is occasionally prolonged into a slight cusp (pl. xix, fig. 57, *b*). Pleural teeth 4 in older portions of the radula, usually 5 toward the sheath, large, strongly hooked, of nearly the same size and shape, the shaft with a winglike expansion on the dorsal side (pl. xix, fig. 55, *a*, 58). Uncini (pl. xix, figs. 56) 7 to 8 in number, the first ones slightly prismatic in form, gradually becoming reduced to elongated flattened plates. The first 4 or 5 of nearly the same size, then decreasing rapidly to the outermost ones. A well-developed longitudinal crest, directed toward the median line and slightly overlapping the adjacent tooth, is borne by all except the outermost 2 or 3 uncini.

The œsophagus is relatively short, being but 3 mm. in length, is curved to the left, and passes into the large thin-walled saccular stomach, the greater portion of which lies in front of the liver and entirely free from that organ, its pyloric portion only being inclosed in a deep oblique furrow which divides that organ into a smaller anterior and a larger posterior lobe. The intestine courses to the left in this groove, doubles downward and forward, thence describing a loop upward to the dorsal surface of the viscera, where it passes in a wide curve over the surface of the anterior genital mass posteriorly to the anus.

The hermaphroditic gland covers the anterior upper face of the liver, its duct arising from the upper surface close to the pyloric end of the stomach by the union of two main branches, which are lost in fine ramifications in the substance of the gland. The duct is short, dilating into the long convoluted whitish ampulla which courses forward, passing beneath the anterior genital mass in a series of loopings in a groove between the nidamental gland on the right and the large spermatotheca on the left. The total length of the hermaphroditic ampulla is about 12 mm., nearly one-half the total length of the whole animal. At the anterior face it passes into the nidamental gland, giving off the spermatic duct, which emerges from the substance of the gland and at once dilates into the thick lobulated prostate gland. This organ is broad and describes an S-shaped loop upon the anterior and inner faces of the anterior genital mass, forming with the spermatotheca, which it closely covers, fully one-half the bulk of the mass. Its distal end passes into the narrow muscular vas deferens, which, after a very short and somewhat tortuous course, dilates into its spindle-shaped ampulla, 2 mm. long and 1 mm. in diameter, lying obliquely upon the dorsal face of the anterior genital mass and inclosed in the loop of the intestine. The wall of this ampulla is very much thickened and muscular. Beyond it the vas deferens doubles outward upon itself and courses obliquely forward and outward, dilating into the præputium, a cylindro-conical structure 2.5 mm. long and 1.5 mm. in greatest diameter. At its base projects the blunt glans penis, armed with minute hooks.

The vagina is short and cylindrical, passing straight inward for 2.2 mm., when it makes a sharp turn posteriorly and, tapering for 1.5 mm., passes into the much narrower vaginal duct, which, with a length of 1 mm., opens into the spermatotheca upon its upper face. The spermatotheca is a large spherical organ, 2 mm. in diameter, its anterior lower and inner faces nearly covered by the loops of the large prostate gland, which also overlaps a portion of its upper surface. The exit of the uterine duct from the spermatotheca is 1 mm. distant from the entrance of the vaginal duct and is situated upon its anterior face. The uterine duct is slender and passes downward and outward, being completely concealed by the overlying lobules of the prostate. It is about 2.5 mm. in length, and just before entering the nidamental gland receives the duct of the spermatocyst, a small pear-shaped sac lying upon the upper anterior face of the anterior genital mass, its surface exposed between the distal portion of the vas deferens and the top of the prostate gland.

The nidamental-albumen gland complex is small, about 2.5 mm. in length, 2 mm. in height, and 1 mm. in thickness. Its outer surface is convex, the inner irregularly faceted. The gland is about equally divided between the albuminous and nidamental portions, the former occupying the upper and the latter the lower portions, respectively. The relations of the ducts are as usual.

The largest specimen taken had a total length of 52 mm., breadth 10 mm., and height 11 mm., though the majority of individuals are much smaller than this, averaging perhaps 30 to 40 mm. in length.

Habitat: Abundant everywhere during the summer months in rocky tide pools all along the coast from Monterey to Point Lobos. During the winter months it is not so abundant, but is never entirely lacking.

Type no. 181276, U. S. National Museum.

15. **Triopha grandis** MacFarland.

[Pl. xxviii, fig. 19; pl. xix, figs. 60-64.]

Triopha grandis **MacFarland**, op. cit., p. 50.

Body large, the largest specimen measuring 80 mm. in length, 25 mm. in width, and 30 mm. in height in alcoholic material. Plump, not at all depressed nor compressed, highest in region of the heart and sloping rapidly backward to tip of the short, blunt tail, more gently sloping forward.

Head flattened above, with a conspicuous semicircular frontal margin bearing 8 to 12 tuberculate or branched processes (pl. XXVIII, fig. 19). Frontal margin extending laterally well beyond the region of the rhinophores. Dorsum arched, smooth, of a yellowish-brown color, flecked everywhere with bluish spots or entirely plain, the processes of frontal margin and dorso-lateral region, the tips of the branchiæ, and tip of the tail yellowish red. Dorso-lateral margin marked out by a series of 4 to 6 branching processes similar to those of the frontal margin but longer, reaching a length of 10 mm., the branchings quite short.

Foot linear, rounded in front, more gradually tapering behind to the bluntly pointed tail.

Mouth directed obliquely downward, the tentacles blunt, auriform, 3 mm. long, the outer half in the form of a rolled plate, the opening upward.

Rhinophores fairly large, perfoliate with about 20 leaves, the stalk stout, conical, the clavus conical, inclined backward, completely retractile within conspicuous cylindrical sheaths with smooth margins.

Branchiæ 5 in number, tri- and quadripinnate, wide spreading, their bases separate, arranged in a circle around the anus. Anal opening at the top of a large cylindro-conical papilla, the renal opening slit-like, situated on the base of the anal papilla at the right anterior side.

Pharyngeal bulb large, slightly conical, not depressed nor compressed, the radula sheath projecting from the ventro-posterior surface as a rounded enlargement. Salivary glands long, band-like, 2 mm. broad, extending back under the liver for about 10 mm., the distal ends connected in a loop.

Labial disk oval, but slightly convex, the opening vertical, an irregularly inverted Y-shape below, on either side below the mandibles a deep fold. Within the opening the colorless cuticula passes over above, laterally, into the light-yellow mandibles, which are elongate triangular in shape, much reduced in size as compared with other species of this genus, occupying less than the upper half of the sides of the flattened oral tube. The mandibular plates are about twice as long as broad, and are made up of short, slender, slightly-curved, elastic, blunt rods from 2 to 6 μ in diameter, the longest at dorso-anterior margin and decreasing in length behind and below.

Radula large, broad, straight, deeply grooved, the deep amber teeth in 18 rows, of which the last 2 are immature.

Rhachis broad, with 4 series of flattened plates (spurious teeth). The 2 median rows (pl. XIX, fig. 60, *a*) of nearly equilateral rectangular form throughout the whole radula, their length and width being about 0.270 mm. About one-fourth the length of the plate behind its anterior margin it is thickened into a sharply defined transverse cutting ridge of a light-yellow color, contrasting strongly with the grayish remaining portion of the plate. About one-third the length of this ridge, from the inner margin of the plate, a fainter longitudinal ridge, sloping toward the anterior margin, joins it (Pl. XIX, fig. 60, *a*), and in the posterior portion of the radula a similarly placed ridge toward the outer side of the radula may mark off with it a rectangular elevated area (pl. XIX, fig. 61). Margins of the plate irregular, especially the posterior one. In the posterior portion of the radula the region of the plate behind the transverse ridge tends to become convexly thickened in its inner median area (fig. 61). The plates of the outer series (pl. XIX, fig. 60, *b*) of the rhachis are triangular in general shape and of a light-yellow color. The anterior inner angle is sharp and thickened, the other two rounded and thinner. The antero-lateral border is thickened and slopes upward into a strong, rounded, longitudinal elevation, which terminates posteriorly in a heavy, blunt cusp, its apex forming a shoulder on the antero-lateral border just below the anterior angle of the tooth.

Pleuræ (pl. XIX, fig. 62) with 8 strong, large, amber-yellow teeth of similar form, strongly hooked, decreasing in size but little from within outward. In the anterior region of the radula the number may be reduced to 7. The body of each tooth is long, obliquely placed, slightly curved, and twisted at its lower end toward the median line of the radula. The hook is large, directed slightly inward, and flattened dorso-ventrally with a broadly pointed cutting edge. A small, inwardly directed wing-like expansion is borne on the basal portion of the shaft.

Uncini (pl. XIX, fig. 63) prismatic, amber colored, 8 in number, the shape of the first ones much resembling the bodies of the pleuræ with occasional indications of a hook above. The inner 4 of nearly the same size, their length about 300 mm., width about 70 mm., the outer 4 becoming flattened and decreasing rapidly in size, the outermost one being colorless and almost rudimentary. A longitudinal wing-like crest projects toward the median line, often overlapping the adjacent tooth, as in the other species of this genus.

The large lobulated blood gland lies upon the front portion of the anterior genital mass, extending transversely from the median line toward the right side for a distance of 10 mm. It is flattened, thin, and deeply divided into lobules.

Hermaphroditic gland large, concealing the liver; the hermaphroditic duct, narrow at first, after a course of about 8 mm. passes into a very long, more dilated portion, which is coiled in irregular corkscrew-like windings against the inner posterior flattened face of the large hemispherical mass formed by the nidamental and albumen glands. Straightened out this duct measures about 60 mm., a length nearly equal to that of the whole animal. Near the anterior end of the above glands it divides into the the spermatic duct and the oviduct. The spermatic duct passes almost directly into the prostate gland, which is large, slightly flattened, looped closely upon itself, minutely lobulate, and has a total length of about 20 mm. and a maximum diameter of about 3 mm. Leaving the distal end of the prostate gland, the vas deferens, after a short (2 mm.) narrow portion, dilates into the long ampulla. This organ is of a cylindro-conical shape, slightly broader (2 mm.) at its proximal end than at its distal one, about 5 mm. in length, and with thick muscular walls. Beyond the ampulla the duct continues for about 8 mm., dilating gradually and passing into the penis sheath, which is about 6 mm. long by 3 mm. broad. Upon its dorsal surface lies the small, rounded genital ganglion borne upon a branch of the pleural commissure. The glans penis and the distal end of the vas deferens are closely set with minute, erect, claw-like hooks (pl. XIX, fig. 64) for a distance of about 2 mm., becoming more scattered and fewer toward the inner limit of their occurrence. Length of teeth about 42 mm., diameter of base about 12 mm., their tips directed toward the opening of the duct in the completely retracted glans.

The oviduct is as usual in the genus. The very large spermatotheca, about 10 mm. in diameter, occupies nearly the whole of the upper portion of the genital mass; its inner duct is short and receives the short duct of the 5 mm. long, pear-shaped spermatocyst, its distal portion, about 8 mm. long, gradually dilates into the vagina.

The above structural characteristics distinctly mark out this form as a species of *Triopha* totally distinct from the remaining three Pacific coast species. During the summers of 1893 and 1894 it was quite abundant upon the brown kelps, *Nereocystis* and *Macrocystis*, off Point Aulon and Point Pinos. Since then it has been taken at intervals from the same habitat, but in fewer numbers, the large kelp beds having almost entirely disappeared along the coast between Monterey and Pacific Grove. It has never been taken in shore collecting, where *Triopha carpenteri* and *Triopha maculata* are common.

Type no. 181283, U. S. National Museum.

Radulæ of species of Triopha.

	Number of rows.	Number of pleuræ.	Number of uncini.	Authority.
Tr. modesta Bergh	21-28	4-7	10-13	Bergh.
Tr. carpenteri (Stearns)	33	9-18	9-18	MacFarland.
Tr. maculata MacFarland	14	4-5	7-8	Do
Tr. grandis MacFarland	18	8	8	Do.

Genus 13. POLYCERA Cuvier.

Polycera Cuvier, Regne Anim., 1817, II, p. 390; ed. 2, 1830, III, p. 52.—Bergh, Beitr. zu einer Monographie der Polyceraden, I, Verh. d. k. k. zool.-bot. Ges. Wien, XXIX, 1879, p. 599. System der Nudibr. Gasteropoden, 1892, p. 150.

Body limaciform, nearly smooth; frontal margin digitate; rhinophores nonretractile, clavus perfoliate; branchiæ of few leaves, simply pinnate; upon each side of the branchiæ a single larger digitiform extrabranchial appendage; tentacles short, lobiform.

Mandibular lamellæ with a winglike process above. Radula rather narrow; rhachis naked; lateral teeth 2 large unequal ones and several external ones.

Prostate large. Glans penis armed.

16. Polycera atra MacFarland.

[Pl. xxix, fig. 22; pl. xx, figs. 65–72; pl. xxi, figs. 106, 111.]

Polycera atra MacFarland, op. cit., p. 50.

Body limaciform, smooth, plump, highest in front of branchiæ, sloping backward to the short, pointed tail. Slightly contracted in front of heart, then somewhat expanded in the slightly flattened head. Head rather high, sloping downward in front, bearing a moderately wide horseshoe-shaped frontal margin carrying 4 slender pointed processes (pl. xxix, fig. 22). At the sides of the rhinophores this veil is slightly dilated, carries one or two short, pointed, angular processes (pl. xx, fig. 65), and is continued laterally into a more or less elevated dorso-lateral ridge, highest in the region of the branchiæ, where it bears one or two compressed, pointed tubercles, sometimes elongated into short processes (pl. xxix, fig. 22). The conspicuous lobe of *P. quadrilineata* is here represented by a low tubercle of varying height. Behind the branchiæ these ridges unite in a low median crest to the tip of the tail.

Gill plumes simply pinnate, 8 in number, nonretractile, tallest in front, and decreasing regularly in size from before backward.

Rhinophores stout, nonretractile into sheaths, the stalk conical, the clavus club-shaped, perfoliate, slightly inclined backward.

General body color black (pl. xxix, fig. 22), dorsum and sides with numerous rows of yellow spots more or less confluent into continuous lines. The intermediate spaces between these yellow spots in longitudinal series is grayish, as are also the basal portion of the frontal veil and the foot. Frontal processes, tips of rhinophores and dorso-lateral tubercles or processes yellow. Branchial plumes with a series of yellow spots, the tips also of the same color. Foot linear, the anterior angles prominent (pl. xx, fig. 65). Tentacles very short, lobiform.

Anal opening at summit of low, cylindrical papilla in center of circle of gill plumes. Renal opening slitlike, at the right and in front of the anal papilla.

Reproductive apertures as usual in the genus, on right side midway between the anterior margin of head and branchiæ, the penis opening rounded, the vaginal and gland openings guarded by a fold of the skin.

Size: Length up to 23 mm., breadth up to 6 mm., height in heart region 7 mm.

Pharyngeal tube short, pharyngeal bulb nearly spherical, very muscular, its length about 3 mm., breadth 3 mm., height 2.5 mm., the strong cutting face of the mandibles projecting in front and above. Mandibles strong, of a light yellow color, the anterior cutting face very oblique, made up of two portions, the ventro-anterior cutting portion and the dorso-lateral arched wings (longitudinal and transverse portions of Bergh's description of *P. quadrilineata*, 1879, p. 606). The cutting portion, of a deep yellowish-brown color, strong and thick, presents an outer arched shieldlike surface which is strongly marked with concentric lines, indicating the laminated structure clearly seen in section, as in figure 68. Upper anterior ends of the cutting portions approximated, rounded, the lower posterior ends divergent and curved backward and upward. Laterally and above the cutting portion is continued into the arched plate (pl. xx, fig. 67, *b*), the anterior margin of which is strongly concave, its superior and posterior margins rounded. The relation of the two plates is best shown in the section, figure 68, taken along the line *a b* of figure 66, from which it is evident that the cutting portion forms the expanded and thickened ventro-anterior border of the dorso-lateral wing. Seen in front view the line of junction of the external face of the wing with the cutting plate forms a clearly defined line, as shown in figure 72, *a*.

Radula rather deeply grooved, of a rich amber color in the posterior teeth, deepening anteriorly to a dark brown. Teeth in 9–10 rows, of which the last one is rudimentary, the halves of the rows of teeth in not exactly a straight line across the radula (pl. xxi, fig 111).

Rhachis naked, not narrow, in width about 0.3 mm.

Pleural teeth 2 (pl. xx, fig. 69; pl. xxi, fig. 111), unequal, the first smaller than the second, alike in shape, the stout shaft flattened, slightly concave upon its inner surface, bearing upon its outer margin a broad triangular winglike expansion directed toward the median line. The lower end of the shaft rounded, the upper end bearing a large smooth-edged hook at right angles to the shaft. Length of first rhachidian tooth 0.300 mm., of second 0.412 mm.

Uncinal teeth 3, triangular prismatic in form, decreasing in length and width from within outward. Each bears a sharp crest upon the upper two-thirds of its inner border, from which the upper surface slopes outward, the inclination decreasing in the second tooth and nearly disappearing in the third. Lower end of the uncini rounded, the upper triangular and sloping inward. Length of first uncinus 0.202 mm., of second 0.165 mm., of third 0.099 mm. Occasionally a rudimentary fourth uncinal tooth may be found (pl. XX, fig. 70), but this is of rare occurrence.

Nervous, vascular, and digestive systems present no striking distinctive characters different from the other species of the group.

Blood gland irregularly lobulate, lying upon aorta at anterior end of the genital mass. About 1 mm. long, 2 mm. wide, and 1 mm. thick in large individuals.

Reproductive system: Ovotestis thin, covering the whole of the liver. Hermaphrodite duct delicate, thin-walled, short, its ampulla not long, its walls thicker, slightly dilated, dividing at anterior face of nidamental gland into spermatic duct and oviduct. Spermatic duct short, looped in close contact with nidamental gland and passing into the large prostate gland, which is made up of a flattened loop of the glandular tube, the whole closely bound together in the form of a concave disk of about 2 mm. diameter, lying upon the anterior face of the spermatotheca. From its anterior end is given off the narrow vas deferens, about 0.2 mm. in diameter and 5 mm. long. No ampulla other than a very slight dilation of the duct is to be found (pl. XXI, fig. 105 *amp*). Glans penis truncately conical, closely set with minute, curved teeth, the largest 8 μ in height by 2.5 μ wide (pl. XX, fig. 71), arranged in rows, the total length of the armature in the retracted glans and the vas deferens together being about 1 mm. Vaginal duct and uterine duct given off from a common duct, about 0.1 mm. long at the outer side of the spermatotheca. The very narrow, thin-walled uterine duct receives the 0.4 mm. long duct of the spermatocyst and doubles its diameter, and after a course of about 3 mm. opens into the spermatotheca, for the last half of its length being closely attached to the vaginal duct. Spermatocyst (pl. XXI, fig. 105 *sp. c.*) ellipsoidal, 1 mm. long, 5 mm. broad, its duct extremely narrow. The spermatotheca (pl. XXI, fig. 105 *sp. th.*) large, about 2 mm. in diameter, spherical, on lower median side of the genital mass forming one-half of its total volume. The vaginal duct, about 5 mm. long and 0.3 mm. in diameter, gradually dilates at its distal end into the vagina.

Habitat: On brown algæ in rocky tide pools from Monterey to Cypress Point. Especially abundant at Point Alones (Chinatown Point). Common.

The structural characteristics of *Polycera atra* clearly separate it from any other species of *Polycera* hitherto described. The low extrabranchial appendages resemble those of *Palio pallida*, described by Bergh (1880) from Alaskan waters, but the coloration, the long frontal processes, the mandibles, radula, and reproductive apparatus are all decidedly different.

Type no. 181278, U. S. National Museum.

Radulæ of species of Polycera and Palio.

Species.	Number of rows.	Number of uncini.	Authority.
P. quadrilineata	15	4	Alder and Hancock.
P. quadrilineata	12-13	4-5	Meyer and Moebius.
P. quadrilineata	14-15	4	Bergh.
P. lessonii	16-18	8	Do.
P. lessonii	13	6	Alder and Hancock.
P. ocellata	16	5	Do.
P. ocellata	13-15	5-7	Meyer and Moebius.
P. pallida	18	5	Bergh.
P. atra	9-10	3-4	MacFarland.

Subfamily XII. GONIODORIDINÆ.

Body oval, more or less depressed, pallial margin strongly prominent; or elongate, sometimes limaciform, the dorso-lateral margin sometimes with simple appendages. Rhinophores often with sheath, retractile or nonretractile, the clavus perfoliate; branchiæ rarely of few plumes, usually of many, the plumes usually simply pinnate, rarely tripinnate, often arranged in horseshoe form. Tentacles small, lobiform; the foot usually wide, rarely narrow, rounded in front or with prominent angles.

Pharyngeal bulb supplied on its upper surface with a sessile or petiolated sucking crop (ingluvies). Labial disk covered with simple cuticle or armed with a ring of hooks or mandibular plates. Radula more or less narrow; rhachis naked or occasionally with spurious teeth; pleuræ usually with a single large hooked tooth, occasionally two hooked ones, and with usually few, sometimes many, external teeth.

Glans penis usually armed with a series of hooks.

Genus 14 ACANTHODORIS Gray.

Acanthodoris Gray, Fig. Moll. Animals, IV, 1850, p. 103. Guide Moll. Brit. Mus., 1857, p 207.—Alder and Hancock, Mon. Brit. Nudibr. Moll., VII, 1855, p. 43; Ap. p. XVII.—G. O. Sars, Moll. Reg. Arct. Norvegiæ, 1878, p. 308.—Bergh, Gattungen nördischer Doriden, Arch. f. Naturgesch., XLV, 1, 1879, p. 356. Nudibr. Moll. North Pac., II, Proc. Acad. Nat. Sci. Phila. 1880, p. 237. Monog. d. Polyceraden, III, Verh. d. k. k. zool.-bot. Gesch. Wien, XXXIII, 1883, p. 170. Malacol. Unters., H. XVII, 1890, p. 988. System der Nudibr. Gasteropoden, 1892, p. 158.

Body soft, subdepressed; notæum thickly covered with short villi; margin of rhinophore aperture lobed; branchial plumes few, tripinnate, arranged in a circle; head wide, veliform, tentacles short, lobiform.

Armature of labial disk of minute hooks, below with projecting thickenings of the cuticle. Radula rather narrow; rhachis naked; first pleural tooth very large, hooked, external pleural teeth few (4–8), smaller. Buccal crop connate with pharyngeal bulb.

Glans penis armed; vagina very long.

17. **Acanthodoris hudsoni** MacFarland.

[Pl. XX, figs. 73–80.]

Acanthodoris hudsoni MacFarland, op. cit., p. 51.

Body plump, highly arched, slightly higher and broader in front than behind, the general body outline oval. Dorsum soft, villous everywhere, covered by small, thickly set, bluntly conical papillæ (villi), but slightly retractile. Margin of mantle everywhere overlapping the foot except at tip of the tail, its margin broad and rather thick.

General ground color of dorsum and ventral surface clear translucent, yellowish white, or pinkish, the papillæ and branchial plumes tipped with lemon yellow, the mantle edged with the same color.

Length of animal up to 35 mm., breadth up to 22 mm., and height 9 mm.

Head (pl. XX, fig. 73) wide, veliform, the sides prolonged into broad, triangular, pointed tentacles, a wide, rounded notch between them in the median anterior margin of the head. Mouth a small longitudinal slit.

Foot broad, rounded abruptly, and slightly concave in front, the sides very slightly tapering toward the posterior end, where it is less abruptly rounded to the blunt tail.

Rhinophores long, tapering, inclined forward, the clavus recurved and inclining slightly backward. Perfoliate with about 24 leaves, the length of clavus and stalk nearly the same, about 5 mm., the whole organ 10 mm. long with a basal diameter of 2 mm. Retractile into a low sheath, the margin of which bears numerous short papillæ similar to those of the dorsum.

Branchial plumes 5, bipinnate, nonretractile within sheath, widespreading, arranged in a circle inclosing the anal papilla and numerous slender papillæ similar to those of the general dorsum. Anal opening at the summit of a low blunt papilla, connate to the sides of which are 3–5 slender-pointed processes forming ridgelike lateral elevations and extending beyond the summit. Pseudoperitoneum sparsely sprinkled anteriorly with fine dark flecks. Blood gland elliptical, light colored, disk-like, about 1 mm. long by 1.5 mm. wide and 0.5 mm. thick, lying transversely above the central nervous system.

Pharyngeal bulb 2 mm. long, 2.5 mm. high (including crop), and 1.3 mm. in width. The crop conspicuous, hemispherical, with a narrow median longitudinal muscular band, the sides ridged with muscular bands converging toward the under portion, its walls very thick. The radula sheath projecting behind and below for 0.5 mm. No conspicuous esophageal diverticulum at anterior end of the esophagus as in *A. brunnea* from the same locality.

Labial disk oval, convex, about 0.9 mm. in diameter; its cuticle thin and colorless. The light yellow armature (pl. xx, fig. 74) a pavement of minute hooks (pl. xx, fig. 79) confined mainly to a triangular area on the lower and lateral borders of the opening. The lowermost portion of the labial armature is free from hooks and is occupied by a broad, slightly concave thickening of the cuticle, narrowing to a point posteriorly and anteriorly forked, divergent into two bladelike processes which project freely a short distance from the margin (pl. xx, figs. 75, 76), the whole structure being shaped much like an arrowhead, the point directed backward and extending into the colorless cuticle lining the entrance to the pharyngeal bulb, its total length 0.288 mm.

Radula very narrow, with a deep U-shaped groove. Teeth in 27 rows, the last 3 rudimentary. Rhachis very narrow, naked. First pleural tooth (pl. xx, fig. 77) very large, upright, compressed, its base quadrangular in lateral outline, the posterior border thin and overlapping the outer anterior margin of the first pleural tooth of the succeeding row. Lower portion of the base rounded in front, strongly thickened. Height of base about 0.210 mm., its length 0.114 mm. The anterior portion prolonged upward into a strong slightly curved hook about 0.180 mm. in length, upon the inner margin of which is a series of 5–7 denticles midway of its length, decreasing rather irregularly in size from above downward. In the older, more anterior teeth of the radula, the number of denticles is occasionally increased to 10–11, the lowest 4–5 being extremely small. Length of the largest denticles about 0.008 mm.

The remaining pleuræ, 5–6 in number, are small and of nearly the same size, oblique, the basal portion thickened, the upper margin portion prolonged posteriorly into a slightly flattened, bluntly pointed hook with a thin, keellike plate below, the general shape resembling that of the first pleural tooth (pl. xx, fig. 78). Average length 0.05 mm.

Hermaphroditic gland very thin, covering nearly all of the liver, its duct thin walled, slender, about 0.6 mm. long by 0.1 mm. broad, arising from the right anterior lobe of the visceral mass near the median line and passing in a short loop into its dilated ampulla. Anterior genital mass small, plano-convex, its superior border occupied by the glandular portion of the vaginal duct, the spermatotheca, and the spermatocyst, its inner flattened face by the loops of the ampulla of the hermaphroditic duct, its outer convex face formed by the nidamental and albumin glands. The ampulla of the hermaphroditic duct describes a short loop upon the inner face of the nidamental gland, passes forward and upward, describing almost a complete circle, gives off the spermatic duct, and passes at once into the nidamental gland. Length of ampulla 3 mm., its diameter 0.5 mm.

The spermatic duct describes an 8-shaped loop closely attached to the anterior margin of the genital mass, passes backward in a long free loop underneath the anterior end of the visceral mass near the median line, returns upon itself, and passes into the penis. Total length about 8.5 mm., diameter 0.2 mm. Penis cylindro-conical, 1 mm. long by 0.4 mm. wide, the retracted glans bluntly conical, armed with very minute hooks, occupying nearly the whole length of the hollow præputium.

The uterine duct (pl. xx., fig. 80, *u. d.*) is very slender and short, passing directly from the anterior inner margin of the nidamental gland to its superior margin, where it receives the slightly wider duct of the pear-shaped spermatocyst (0.5 mm. long) (pl. xx, fig. 80, *sp. c.*), and passes immediately into the spermatotheca. The spermatotheca (pl xx, fig. 80, *sp. th.*) is small, about 1 mm, in diameter, spherical, and concealed entirely by the overlying portion of the vaginal duct. The total length of the vaginal duct is about 7 mm., its proximal portion describing an S-shaped loop (pl. xx, fig. 80, *a.*), and dilating rapidly into the glandular portion (pl. xx, fig. 80, *gl.*). This glandular part is thickened; its walls of large gland cells, the lumen narrow; its total length about 1.2 mm. Its external surface bears 4 equidistant longitudinal grooves, and the intermediate portions are transversely lobulated at intervals, the general outline in cross-section being that of a quatrefoil. The distal portion of the vaginal duct is nearly straight, about 4 mm. in length, and passes over insensibly into the vagina (pl. xx, fig. 80, *v. d.*).

Habitat: Tide pools at extreme low water, near Point Pinos. Rare, but 4 specimens of this interesting species having been taken.

Acanthodoris hudsoni differs markedly in the details of its radula armature, and also in the reproductive system, from any other species of this genus, especially from the forms recorded thus far from the Pacific coast. Bergh (1880) has described *Ac. pilosa* var. *albescens*, and *Ac. pilosa* var. *purpurea*, together with a new species, *Ac. cærulescens* from Alaska. These are all strikingly different from *Ac.*

hudsoni and the following form here described, which are the only ones of this genus yet taken from Monterey Bay or its vicinity.

The specific name here given is in recognition of the masterly work of my friend Mr. Charles B. Hudson in the illustration of various animal forms.

Type no. 181289, U. S. National Museum.

18. **Acanthodoris brunnea** MacFarland.

[Pl. XXIX, figs. 20, 21; pl. XX, figs. 81-88a; pl. XXI, fig. 104.]

Acanthodoris brunnea MacFarland, op. cit. p. 52.

Body outline oval, convex, broadest in front about in the region of the rhinophores, the mantle firm and thickly set everywhere with conical tubercules having rounded tips (Pl. XXIX, figs. 21, 20.) Tubercules of varying size and of no definite arrangement save that the smaller ones almost invariably alternate with the larger (about 1 mm. in diameter). Mantle everywhere covering the foot except posteriorly when the animal is in motion, its margin broad and rather thick. General color of dorsum brown, flecked with irregular blotches of black in varying amount (pl. XXIX, fig. 21). Between the tubercules numerous small spots of light lemon yellow, the mantle edged more or less completely with the same color. Stalks of branchial plumes yellowish brown, marked on the inner side with two narrow longitudinal lines of dark brown, the branchiæ tipped with lemon yellow. Rhinophores deep blue-black, tipped with yellowish white. In alcoholic specimens the general darker color is well retained, the yellow tending to disappear.

Total length of animal 19-22 mm., width 9-15 mm., height 7-9 mm.

Head large, veliform, concealed by mantle (pl. XXIX, fig. 21), continued laterally into the wide flat tentacles, in front with a slight median concavity. Tentacles broad, recurved, bluntly pointed at tips, their anterior curved margin thin. Mouth a longitudinal slit. Foot oval, nearly quadrangular, its anterior and posterior ends bluntly rounded. General color of under surface yellow, the lower face of mantle, the head, tentacles and sides of body sprinkled with fine dark brown or black dots.

Rhinophores long, cylindro-conical, tapering to blunt tips, inclined forward and outward, perfoliate with 20-28 thin, slightly oblique laminæ, the lower ones occupying the front of the clavus only (pl. XXI, fig. 104). Stalk one-half the length of the laminate portion. Color deep blue-black, tipped with yellowish white, the laminæ edged with a very narrow line of white, not noticeable without a hand lens. Fully extended length, 8.5 mm. Retractile within a low sheath, the margin of which is prolonged into 6-8 lobes resembling the dorsal tubercules, but somewhat flattened. Three of these are as high as the dorsal tubercules and are placed at equidistant intervals, one external, the other two antero-median and postero-median, respectively, the intervals between them being occupied by lower similar ones (pl. XXI, fig. 104).

Branchial plumes 7, wide spreading, bipinnate, nonretractile within a sheath, arranged in an incomplete circle about the anal papilla on posterior dorsum. About 10 tubercules are included within the rosette, 4-5 of them large and inclosing the anal papilla, which is about one-half the height of the largest tubercules, and is edged with a narrow line of yellow.

Pseudo-peritoneum thickly sprinkled with fine black pigment. Blood gland lobulated, white, placed transversely upon the central nervous system, overlapping in front the large proximal convoluted portion of the salivary glands, which is coiled at the sides and upon the small œsophageal diverticulum.

The pharyngeal bulb is strong, its height, including the crop, is 3 mm., length 2.3 mm., width 2 mm., the radula sheath projecting behind and below for 1 mm. Crop large, spherical, constricted longitudinally into two symmetrical halves about 2 mm. long by 3 mm. wide. The sides are ridged laterally by the converging muscles to the lower anterior portion, the walls very thick and muscular. Base of crop joined directly to the dorsal portion of the pharyngeal bulb, with no trace of a petiole. Labial disc round, convex, its light brown cuticle radially striated, the opening elongate, slit-like, the ends dilated. The labial armature is made up of a band of mosaic-like plates, about 0.240 mm. in width, incomplete above. Each plate is in the form of a minute erect hook, its apex directed outward, either pointed or blunt sometimes bifid (pl. XX, fig. 83). Height of a typical labial element, 0.007 mm. At the lower margin of the labial armature (pl. XX, fig. 81) a single flattened plate-like concave thickening of the cuticle projects freely forward for 0.082 mm., its width 0.033 mm. at the base, the free end about 0.05 mm., with a total length of about 0.270 mm., blunt and jagged as though broken off, its proximal portion extending across the whole band and interrupting the continuity of the hooks below (pl. xx, fig. 82).

Radula narrow, deeply grooved, the teeth in 24–28 rows, the last two of which are rudimentary. The oldest teeth colorless, those toward the posterior end of the radula light yellow.

Rhachis very narrow, naked. First pleural tooth (pl. xx, fig. 84) large, upright, compressed, its base quadrangular in lateral outline and overlapping the outer anterior margin of the first pleural of the following row. Lower portion of the base strongly thickened, upon its upper posterior border a squarish thickened shoulder directed obliquely upward. Height of base about 0.192 mm., its length 0.066 mm. The anterior portion of the base is prolonged upward into a strong, slightly curved hook about 0.150 mm. in length, upon the inner border of which is a series of 14–19 denticles, the longest being 0.012 mm. in length. The remaining pleuræ, 6–7 in number, are small, borne obliquely on the radula, and decrease regularly in size outward. The first of the outer plates (pl. xx, figs. 85, 86) are depressed, flattened above, bluntly pointed behind and have a thin, keel-like plate below, the general shape being somewhat similar to that of the first pleural tooth; the outermost ones are reduced to mere flattened plates (pl. xx, fig. 87).

The anterior genital mass is small, plano-convex, its flattened face directed inward and upward, somewhat oval in shape, with a long diameter of about 4 mm. The hermaphrodite duct is short and very narrow, dilating almost immediately into its whitish ampulla (pl. xx, fig. 88, *h. amp.*) of about 0.5 mm. diameter, with a length of about 6 mm. The ampulla describes an S-formed loop upon the plane face of the anterior genital mass, its lower turn coursing forward and upward along the anterior margin of the nidamental gland, entering into it and dividing into the oviduct and the spermatic duct. The uterine duct (pl. xx, fig. 88, 88*a*, *u. d.*), emerging from the gland, narrows rapidly in passing upward to the superior border of the genital mass, receives the short duct of the pear-shaped spermatocyst, 0.4 mm. long by 0.3 mm. wide (pl. xx, fig. 88*a*, *sp. c.*), and passes into the spermatotheca. The spermatotheca (pl. xx, fig. 88, 88*a*, *sp. th.*) is spherical, about 1 mm. in diameter, with a very short common duct receiving the uterine duct and the vaginal duct. The latter (fig. 88, 88*a*, *vag.*), together with the vagina, is not more than 6 mm. long, much shorter than in any other species of this genus yet described, its diameter gradually increasing from 0.3 mm. to 0.8 mm. and passing without definite boundary into the vagina.

The spermatic duct is very long and much convoluted, its loops lying at the anterior border of the genital mass. The first 9 mm. of its length are closely bound down to the genital mass by connective tissue, have an average diameter of 0.8 mm., and are sharply marked off from the succeeding slenderer portion, which describes a large loop free from close connection with the remainder of the organs. This muscular portion is 0.2 mm. in diameter with a length of 9 mm., the total length of the whole duct thus being 18 mm. It enlarges rapidly at its distal end and passes into the thicker cylindro-conical penis, 3 mm. in length by 1 mm. in average diameter. In the specimens dissected a part of the distal end of the glans was missing, and hence the armature of hooks could not be made out satisfactorily.

Habitat: Dredged off hard sandy bottom in about 10–20 meters depth near entrance to Monterey Harbor. Twelve specimens were taken in two dredge hauls in 1894, and an occasional specimen has been dredged since then near the same locality. Type no. 181293, U. S. National Museum.

Genus 15. ANCULA Lovén.

Ancula Lovén, Index Moll. Scand., p. 5, 1846.—Alder and Hancock, Monog. Brit. Nudibr., III, 1846, Fam. 1, pl. 25; VI, 1854, Fam. 1, pl. 17, fig. 7–8; VII, 1855, pl. 46, Sup. fig. 22; Appendix 1855, p. xviii.—Meyer and Moebius, Fauna der Kieler Bucht, I, 1865, p. 59.—G. O. Sars, Moll. reg. arct. Norv., 1878, p. 364.—Bergh, Beitr. z. Monogr. der Polyceraden, II, 1880, p. 3. System der Nudibr. Gasteropoden, 1892, p. 164.

Body limaciform, smooth; scarcely any frontal veil; rhinophores nonretractile, with two anterior linear basal appendages; branchial plumes 3, tripinnate, with several simple extrabranchial appendages; head small, tentacles rather short, lobiform, somewhat flattened; foot narrow, rounded in front.

Labial armature made up of rows of separate imbricated hooks. Radula narrow, the rhachis naked; first pleural tooth large and broad, its inner margin denticulate, the remaining one much smaller, subtriangular. Buccal crop sessile.

Glans penis armed.

19. Ancula pacifica MacFarland.

[Pl. xxx, fig. 23; pl. xx, figs. 89-92; pl. xxi, figs. 93-96.]

Ancula pacifica MacFarland, op. cit., p. 53.

Body slightly compressed, smooth, limaciform, highest in front of the branchiæ, tapering posteriorly to the tip of the long pointed tail, anteriorly sloping less rapidly to the high rounded head (pl. xxx, fig. 23). General color clear, translucent yellowish white, a narrow median line of orange on dorsum extending from between the rhinophores to the branchiæ, and continued behind the branchial plumes along a slight crest to the tip of the tail. Upon each side along the indistinct dorso-lateral margin a similar orange line extending from the rhinophores to the extrabranchial appendages, continued between their bases and prolonged for a very short distance behind the last one.

Head (pl. xx, fig. 89) bluntly rounded, no frontal veil, the tentacles short, slender, blunt, and slightly flattened.

Rhinophores nonretractile, large, the clavus perfoliate, with 9 yellowish leaves, which are oblique behind and horizontal in front. The stalk of the rhinophores as long as the clavus, cylindro-conical, its base with two long finger-like processes nearly as long as the whole rhinophore, directed obliquely forward and outward, tipped with orange. The distal end of the rhinophore projects beyond the clavus as a slightly enlarged truncate cylinder (pl. xxx, fig. 23).

Branchial plumes 3, nearly equal in size, bipinnate, in part tripinnate, nonretractile within sheaths, a single median anterior plume and a lateral one on each side, the main subdivisions tipped with orange. Immediately behind the bases of the plumes and free from them is the small cylindrical anal papilla, the renal pore situated near its base on the right side and in front. Borne on the dorso-lateral margin on each side of the branchial plumes are 4 blunt, club-shaped processes, dilated above, contracted at the base, the upper third of each light yellow, tipped with orange. In one individual the number of these extrabranchial appendages was reduced to 3 on each side.

Foot narrow, the sides nearly parallel, tapering posteriorly to the tip of the slender tail, the anterior end abruptly rounded.

Dimensions of the largest individual taken: Length 16 mm., breadth 2 mm., height 3.5 mm.

Pharyngeal tube very short, pharyngeal bulb small, 1.5 mm. long by 1.5 mm. high, inclusive of crop, and 1 mm. broad, the sucking crop spherical, prominent, connate.

Labial disk convex, nearly circular, armed with a strong spinous armature, the "prehensile collar" of Alder and Hancock, broadest below (0.150 mm.), narrowing laterally and incomplete above. The elements of the armature (pl. xx, fig. 90) are light yellow in color and arranged radially with 3-6 plates in each row in the lower part. The fundamental shape of these elements is the same, a broad curved base with posterior bifid extremity, in front rounded, the upper surface arched and gradually rising into a blunt hook directed outward. The innermost teeth have strongly curved bases, the outer ones less so, the outermost teeth smallest. Toward the upper part of the ring the teeth become very small, are reduced to the innermost row and have the hook directed sharply outward (pl. xx, fig. 91); the larger ones below are less oblique. The distal end of the hook is minutely serrulate, the denticles thus formed being much smaller and more numerous than in *A. cristata* (4-5, Bergh). The largest plates of the labial armature measure about 0.252 mm. in length, the tip of the hook 0.012-0.015 mm. wide.

Radula narrow, colorless, the teeth in 35 rows increasing in size markedly from front to back of radula, the most posterior teeth being twice the size of the most anterior ones.

Rhachis narrow, bearing a single quadrangular median plate, slightly broader behind than in front (pl. xx, fig. 92) and occasionally giving indications of being made up by the fusion of a pair of plates in the median line. In the first 8-10 rows of the radula these median plates are absent, but are constant in the remaining portion. They are not produced artificially by the breaking off of the basal portion of the first pleuræ as indicated by Bergh for *A. cristata* (1880, l. c.). Length of average median plate 0.018 mm., its width 0.012 mm.

The pleural teeth are 2 in number, the first one large, with an irregular transverse base and a concave, triangular vertical body placed slightly oblique to the median line of the radula. The inner margin is thickened, bears 11-17 recurved sharp denticles, and terminates above in a strong hook (pl. xxi, fig. 93). The height of a first pleural tooth from the middle region of the radula is 0.084 mm.

The second pleural teeth are triangular, thicker below, thin above, terminating in a strong apical hook.

Glans penis (retracted) with an armature of extremely small hooks along its canal for 0.6 mm., in abont 15 rows, the individual hooks 0.004 mm. high.

Habitat: On hydroids and bryozoa in tide pools near Pacific Grove; rare. But eight individuals have thus far been taken. Graceful and slow in movement, rather active in confinement, frequently swimming at the surface.

Type no. 181280, U. S. National Museum.

Genus 16. **HOPKINSIA** MacFarland.

Hopkinsia MacFarland, op. cit., p. 53.

Form of body elongate-oval, very much depressed; the notæum thickly set with long papillæ, simple or occasionally forked; pallial margin not set off from the sides of the body but sloping gradually down into the foot without any distinct boundary, anteriorly continued into a broad velar expansion formed by the fusion of the labial tentacles in front: rhinophores nonretractile, perfoliate, branchiæ several, separate, simply pinnate plumes, arranged in a horseshoe-shaped arc; the foot broad, its margin thin, undulating, in front deeply emarginate, behind forming a short, broad, blunt tail. Head broad, its tentacles very broad and thin, auriculate at the outer posterior angles, in front united into a veil with undulating margin.

Labial armature a ring of very short, thickened rods.

Radula very narrow, the rhachis naked; the first pleural tooth long, erect, hooked, the outer one flattened, horizontal, denticulate.

The genus *Hopkinsia* is perhaps more closely related to *Idalia* than to any other of the Goniodoridinæ. That it forms a valid genus distinct from the latter I have not the slightest doubt, having compared the Mediterranean representatives of *Idalia* with it in detail. As to external features a comparison of figures 24 and 25 of plate XIV with the excellent figures of Alder and Hancock (Monog. Brit. Nudibr. Moll., Fam. I, pls. 26 and 27) or of Bergh (Ueber die Gattung Idalia, Arch. f. Naturgesch. XLVII, 1, 1881, pl. VIII, figs. 1 and 2) shows most striking differences in the general body form which serve to distinguish the genera at sight. The body is very low, not high; the dorsum wide, not narrow; the sides of the body very gently inclined, not abruptly sloping; the pallial margin indistinguishable, not conspicuous; the tail short and rounded, not long and lanceolate; the dorsal papillæ and the undulating marginal veil of the head and modified tentacles are all different. Details of the internal anatomy, notably the pharyngeal and reproductive apparatus, strengthen the conclusion. In an extended morphological study of this genus, which I have in preparation, I hope to take up the question of its relationships in detail.

This new genus is dedicated to Mr. Timothy Hopkins, through whose generous appreciation the foundation of the Hopkins Seaside Laboratory was rendered possible. The type of the genus is the following species.

20. **Hopkinsia rosacea** MacFarland.

[Pl. XXXI, figs. 24, 25; pl. XXI, figs. 97–103.]

Hopkinsia rosacea MacFarland, op. cit., p. 54.

General body outline elongate-elliptical (pl. XXXI, fig. 24), sometimes elongate-oval or almost quadrangular (pl. XXXI, fig. 25), the ends abruptly rounded. Body firm, fragile, the many spicules rendering it almost calcareous, much depressed, the dorsum but slightly arched above and sloping gradually outward to the thin margin of the foot, there being no trace of a pallial margin nor ridge marking the boundary between back and sides.

Foot (pl. XXXI, fig. 25) broad, abruptly rounded behind into a broad and short tail, in front deeply incised by a broad, triangular notch, the margins of which are slightly thickened, the remaining margin of foot and tail thin and undulating.

Head broad, its tentacles very broad, united in front, forming a veil-like expansion with undulating margin, the rounded posterior angles slightly auriculate and free from the anterior outer margin of the foot for but a short distance. The mouth a longitudinal slit.

Dorsum thickly set everywhere with long, gently tapering, soft papillæ (pl. XXXI, fig. 24), many reaching a length of one-half to two-thirds that of the whole animal. The tips of these papillæ are usually pointed and simple, but in nearly every individual branching forms may be found. The branching may be limited to a bifid apex, or the branch may arise along the side. In many cases this branching is due to a fusion of two or more papillæ (pl. XXI, fig. 97). Papillæ most abundant on lateral portions of dorsum and in front of rhinophores, more sparsely scattered on the mid-dorsal region (pl. xxxi, fig. 24).

Rhinophores perfoliate, cylindro-conical, nonretractile within sheaths, of which no trace is present. Thickest below, the smooth, tapering shaft passing gently upward into the conical clavus (pl. xxi, fig. 98). In front the rhachis of the clavus is smooth, behind and laterally are borne about 20 slightly oblique plates, the pairs meeting behind at a very obtuse angle. The upper plates extend farther around the clavus than the lower ones, the extent on the sides and in front decreasing regularly from above downward, the lowest being but slight posterior ridges. Clavus nearly three-fourths the total length of the rhinophore, the whole organ not being as long as the surrounding dorsal papillæ.

Branchial plumes 7-14, entirely separate at the bases, arranged in a wide semicircle or arc approaching horseshoe form, the ends directed obliquely backward (pl. xxxi, fig. 24). The plumes are nearly erect, simply pinnate and free from spicules.

Anal opening small, inconspicuous, situated at the center of the arc of branchiæ. Renal opening very minute, rounded, situated at the right and slightly in front of the anal opening and about 1 mm. distant from it.

Reproductive openings inconspicuous, on right side far forward, on a line with the bases of the rhinophores, immediately below the outermost row of papillæ.

Color everywhere a beautiful deep rose pink (pl. xxxi, fig. 24).

Length of large individual 29 mm., width 16 mm., and height of body alone 5 mm. Length of longest dorsal papillæ 18 mm.

In alcoholic material the pseudo-peritoneum is white, in living specimens slightly pinkish. The blood gland is single, large, broad, and thin, in general outline quadrangular. It fits closely in behind the central nervous system, extending down in lobules between the underlying organs. Length 3 mm., width 2 mm.

The pharyngeal bulb is short and thick, being about 2.4 mm. in length by 2 mm. in width and the same in height, or, including the sucking crop, 3 mm. in height. At the lower posterior border the radula sac projects as a slightly curved, cylindrical process with rounded extremity for a distance of about 1.5 mm. On the dorsal surface of the pharyngeal bulb is borne a strong ellipsoidal sucking crop, 2 mm. long, 1.5 mm. wide and 1.5 to 2 mm. high, attached at its extreme anterior end by a very short narrow petiole. Its walls are very thick and muscular and are lined with a strong cuticula.

The labial disc has a thick cuticula bearing a ring of short thickened rodlets in very close arrangement (pl. xxi, fig. 99). The rodlets are circular to elliptical in outline, narrowest at the outer and inner margins and increasing in width toward the middle of the band. Width of the labial armature 0.4 mm., diameter of widest rods 0.01 mm.

Radula narrow, the teeth in 16 rows. Rhachis extremely narrow, naked. Pleural tooth (pl. xxi, figs. 100, 101) large, erect, long, flattened, its base triangular, broad, thickened above, in length one-third to one-half that of the whole tooth, the shaft flattened, blade-like, in cross section the shape of a saber blade, its posterior border straight, beveled, sharp, the anterior border thickened, curved and rounded; at the distal end is borne a small posteriorly curved blunt hook. In the older teeth of the anterior end of the radula this hook is often broken off (fig. 100) and the whole tooth is more slender than those from the posterior portion (figs. 100, *a*, 101). Total length of average pleural tooth 0.63 mm., length of blade 0.339 mm., length of hook 0.036 mm. The single uncinal tooth (pl. xxi, figs. 100, *c*, 102) is much smaller, thin, depressed, nearly horizontal, triangular in form, the anterior lower edge emarginate, the posterior one more or less pointed and often divided into a series of irregular denticles (fig. 102). This tooth is quite variable in form and is easily overlooked. Length 0.080 to 0.086 mm., greatest width 0.076 mm.

Esophagus narrow, about 0.5 mm. in diameter by 5 mm. in length, passing obliquely downward and backward in the median line to the anterior lower end of the visceral mass, where it dilates into the stomach, which is almost entirely inclosed by the liver, into which it sends numerous large diverticula. The pyloric end narrows into the intestine at the anterior upper end of the visceral mass, which describes an abrupt loop forward to the right in contact with the superior surface of the anterior genital mass, and then courses directly backward to the anus as a thin-walled tube, 1 mm. in diameter at its anterior end and rapidly tapering to a diameter of 0.5 mm. for the greater part of its total length of about 10 mm.

The liver is about 7 mm. long by 3 mm. wide by 25 mm. high, depressed, its upper face convex, the lower flattened, the posterior end slightly conical, rounded, the upper anterior margin occupied by the loop of the stomach. Its whole anterior and nearly all of the lateral faces are closely invested by the pink hermaphroditic gland with its thick pinkish lobules.

The narrow hermaphroditic duct passes obliquely downward from the upper anterior border of the ovotestis for a distance of about 2.5 mm., with a diameter of 0.4 mm., dilating into the large sausage-shaped ampulla. The silvery gray hermaphroditic ampulla (pl. XXI, fig. 103, *amp.*) lies upon the upper and central portion of the anterior genital mass, extending forward to its anterior end, is 3 mm. in length, and has a maximum diameter of 1 mm. At the anterior margin it divides into the spermatic duct and the oviduct, the first of which passes immediately into the enormous white prostate gland (pl. XXI, fig. 103, *pr. gl.*) overlying the whole inner face of the anterior genital mass and forming fully one-half of its bulk. The prostate gland describes a loop backward and then doubles forward in a broad flattened dilation of 4 mm. in length by 2.5 mm. in width, its distal anterior end giving origin to the narrow vas deferens (fig. 103, *v. d.*), which, after a short irregularly coiled portion, passes directly outward and forward into the penis. The retracted penis (fig. 103, *p.*) is about 2 mm. long, its distal end (the glands) bluntly conical, 0.3 mm. in length, and bearing an armature of minute hooks in the last 0.24 mm. of its canal. The oviduct passes directly into the anterior margin of the nidamental gland, and close to its point of entrance appears the uterine duct (fig. 103, *u. d.*), about 0.2 mm. in diameter, coursing backward for 2.5 mm. into the spermatotheca, receiving the slender duct of the spermatocyst just before entering it. The spermatocyst (fig. 103, *sp. c.*) is small, elongate-oval, 1 mm. long by 0.5 mm. broad, and lies upon the mid-dorsal surface of the genital mass at the anterior border of the spermatotheca. Its duct is very slender, being but slightly longer than the cyst itself. The spermatotheca (fig. 103, *sp. th.*) is voluminous, flattened, spherical in form and about 2.3 mm. in diameter, and occupies the upper posterior face of the anterior genital mass. At its anterior face it receives the uterine duct and gives off the vaginal duct very close to its entrance. The latter is a narrow, nearly straight tube about 3 mm. long by 0.2 mm. in diameter, which courses obliquely outward and forward to the short vagina (fig. 103, *vag.*), which is nothing more than its dilated outer extremity.

This beautiful species has been observed at all times of the year, in about equal numbers, under shelving stones between tide marks all along the coast from Monterey to Point Lobos. It has also been taken by Prof. T. D. A. Cockerell at San Pedro. The eggs are laid in the usual spiral form, the band being narrow and of the same color as the animal. The brief summary of its morphological characteristics here given is amply sufficient to show its nonconformity to any of the genera of Goniodoridinæ as yet described. A more complete study of the genus is in preparation.

Type no. 181275, U. S. National Museum.

Family E. CORAMBIDÆ.

Corambidæ Bergh, Syst. d. Nudibr. Moll., p. 165, 1892.

Body doridiform, oval, depressed. Notæum somewhat convex; perinotæum wide, flattened, rounded in front, deeply incised in the median line behind, everywhere projecting beyond the foot. Rhinophores retractile into sheaths, the posterior side of which is longitudinally cleft; the clavus cylindrical, simple, bearing a wing on each side—somewhat rolled backward. Branchiæ of few, separate, simply pinnate leaves on the under side of the posterior mantle margin on each side. Anus postero-median between perinotæum and foot, the renal pore above and at its right. Head concealed by mantle, small, produced laterally into triangular tentacles. Sides of the body very low; on the right anterior side the genital papilla with three openings. Foot narrower than the back, rather wide, emarginate in front, rounded behind.

Pharyngeal bulb with two prominent ridges below in the buccal cavity. Radula rather narrow; the rhachis naked; pleuræ with a larger denticulate tooth and a few (4) external hooked teeth. Buccal crop connate to the pharyngeal bulb.

Glans penis unarmed. (?)

Family F. DORIDOXIDÆ.

Doridoxidæ Bergh, The Danish Ingolf Expedition, II, no. 3, 1900, p. 15.

Form of body as in Dorididæ, but without dorsal branchiæ and with laterally placed anus. Rhinophores as in Dorididæ.

Pharyngeal bulb strong, mandibles very strong. Radula with a large median tooth, pleuræ multi-dentate.

PLATE XVIII.

Archidoris montereyensis (Cooper) Bergh.

FIG. 1.—Outer pleuræ of fourteenth row. × 120. (Camera lucida.)
FIG. 2.—Inner pleuræ of eighth row. × 120. (Cam.)
FIG. 3.—Inner face of twelfth pleural tooth of fourth row. × 120. (Cam.)
FIG. 4.—*v. d.*, vaginal duct; *sp. th.*, spermatotheca; *sp. c.*, spermatocyst; *u. d.*, uterine duct. × 10. (Cam.)
FIG. 5.—Ventral view of anterior end of animal, life size.

Anisodoris nobilis (MacFarland).

FIG. 6.—Ventral view of anterior end of animal, life size.
FIG. 7.—Outer pleuræ. × 83. (Cam.)
FIG. 8.—Pleuræ from middle of row. × 52. (Cam.)
FIG. 9.—Inner pleuræ of eleventh row. × 83. (Cam.)
FIG. 10.—Outer face of innermost pleural tooth of seventh row. × 83. (Cam.)
FIG. 11.—Inner face of large pleural tooth from middle of row. × 52. (Cam.)

Discodoris heathi MacFarland.

FIG. 12.—Ventral view of anterior end of animal. × 4.
FIG. 13.—Inner pleuræ of thirteenth and fourteenth rows. × 146. (Cam.)
FIG. 14.—Inner face of typical pleural tooth. × 83. (Cam.)
FIG. 15.—Labial armature flattened out. × 30. (Cam.)
FIG. 16.—*v. def.*, vas deferens; *pr.*, prostate gland; *sp. d.*, spermatic duct; *ov.*, oviduct; *h. a.*, hermaphroditic ampulla; *h. d.*, hermaphroditic duct.
FIG. 17.—*vag. d.*, vaginal duct; *sp. th.*, spermatotheca; *sp. c.*, spermatocyst; *u. d.*, uterine duct.

Rostanga pulchra MacFarland.

FIG. 18.—Inner pleuræ of 3 rows slightly displaced. *a*, innermost pleural tooth. × 400. (Cam.
FIG. 19.—Isolated pleural teeth seen at various angles. × 400. (Cam.)
FIG. 20.—Outer pleural teeth. *a*, thirtieth tooth; *b*, front view of an outer tooth; *c*, *d*, *f*, distal ends, and *e*, side view of outermost teeth in row. × 400. (Cam.)
FIG. 21.—Labial armature from above. *a*, anterior margin. × 400. (Cam.)

Diaulula sandiegensis (Cooper).

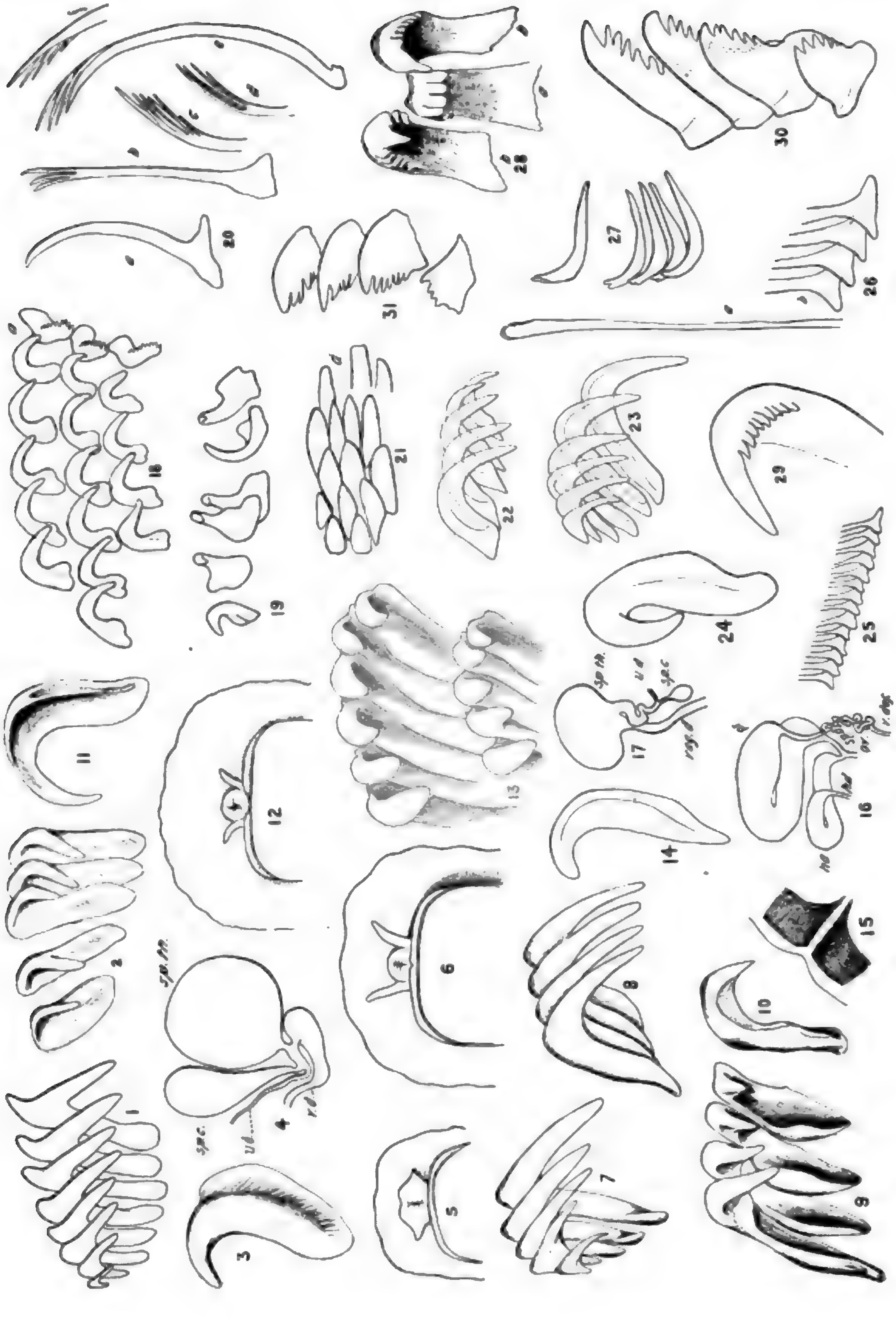
FIG. 22.—Five innermost pleuræ. × 83. (Cam.)
FIG. 23.—Six outermost pleuræ. × 83. (Cam.)
FIG. 24.—Front view of pleural tooth from middle of row. × 120. (Cam.)

Aldisa sanguinea (Cooper).

FIG. 25.—Bases of nineteenth to thirty-second pleural teeth. × 120. (Cam.)
FIG. 26.—*a*, distal end of thirteenth pleural tooth; *b*, basal ends of four pleural teeth. × 146. (Cam.)

Cadlina marginata MacFarland.

FIG. 27.—Hooks of labial armature. × 400. (Cam.)
FIG. 28.—*a*, rhachidian tooth; *b*, first pleural teeth of nineteenth row. × 400. (Cam.)
FIG. 29.—Twelfth pleural tooth. × 400. (Cam.)
FIG. 30.—Outermost pleuræ. × 400. (Cam.)
FIG. 31.—Outermost pleuræ, fifty-third row. × 400. (Cam.)


a
b
c
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sp.m.
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PLATE XIX.

Cadlina flavomaculata MacFarland.

Fig. 32.—Ventral view of animal. × 2.
Fig. 33.—Elements of labial armature isolated. × 400. (Cam.)
Fig. 34.—Rhachidian, *a*, and first pleural teeth of thirteenth to fifteenth rows. × 400. (Cam.)
Fig. 35.—Rhachidian teeth of seventh and eighth rows. × 400. (Cam.)
Fig. 36.—Inner face fourteenth to seventeenth pleuræ. × 400. (Cam.)
Fig. 37.—Outer face of *a*, nineteenth, and *b*, outermost (twenty-third) pleuræ. × 400. (Cam.)

Doriopsis fulva MacFarland.

Figs. 38, 38*a*.—*h. d.*, hermaphrodite duct; *h. amp.*, hermaphroditic ampulla; *sp. d.*, spermatic duct opening into the overlying prostate gland, which is indicated by the dotted line; *sp. c.*, spermatocyst; *sp. th.*, spermatotheca; *u. d.*, uterine duct.
Fig. 39.—Hooks near base of glans. × 120. (Cam.)
Fig. 40.—Hooks at margin of opening of glans. × 120. (Cam.)

Ægires albopunctatus MacFarland.

Fig. 41.—Upper mandible. *a*, anterior margin. × 36. (Cam.)
Fig. 42.—Innermost pleural teeth of sixth row. × 146. (Cam.)
Fig. 43.—Four outer pleuræ of fourteenth row. *a*, outermost. × 146. (Cam.)
Fig. 44.—Fifth and sixth pleuræ of sixth row. × 146. (Cam.)

Laila cockerelli MacFarland.

Fig. 45.—Ventral view of anterior end of animal, showing head, tentacles, sub-pallial ridge (*a*) and marginal papillæ. × 2
Fig. 46.—Inner portion of sixtieth and sixty-first rows of radula. *a*, first pleural tooth; *b*, second pleural tooth; *c*, *d*, third and fourth lateral teeth. × 260. (Cam.)
Fig. 47.—First and second pleural teeth. × 400. (Cam.)
Fig. 48.—Three rhachidian plates (spurious teeth). × 400. (Cam.)
Fig. 49.—*c–n*, third to twelfth lateral (uncinal) teeth. × 400. (Cam.)
Fig. 50.—Hooks of glans penis armature. × 260. (Cam.)

Triopha carpenteri (Stearns).

Fig. 51.—Thirteenth row of radula. × 36. (Cam.)
Fig. 52.—Uncinal teeth, the seventh to fourteenth uncini, inclusive, being omitted. × 83. (Cam.)
Fig. 53.—Outermost (twelfth and thirteenth) pleuræ in front and side view. × 52. (Cam.)
Fig. 54.—Rhachidian plates of eighteenth row. × 52. (Cam.)
Fig. 55.—Labial disc. × 9. (Cam.)

Triopha maculata MacFarland.

Fig. 55*a*.—First to fourth pleuræ of tenth row of radula. × 83. (Cam.)
Fig. 56.—Uncini of tenth row of radula. × 83. (Cam.)
Fig. 57.—Rhachidian plates, *a*, of left median series; *b*, of lateral series. × 83. (Cam.)
Fig. 58.—Fourth pleural tooth, inner face. × 83. (Cam.)
Fig. 59.—Labial disk. × 8.

Triopha grandis MacFarland.

Fig. 60.—Rhachidian plates of tenth transverse row of radula. *a*, plate of left median series; *b*, of lateral series. × 60 (Cam.)
Fig. 61.—Left median rhachidian plate of fourteenth row. × 60. (Cam.)
Fig. 62.—Plural teeth, *a*, first; *b*, eighth. × 60. (Cam.)
Fig. 63.—Uncini of tenth row. × 60. (Cam.)
Fig. 64.—Isolated hooks of glans penis armature. × 260. (Cam.)

PLATE XIX.

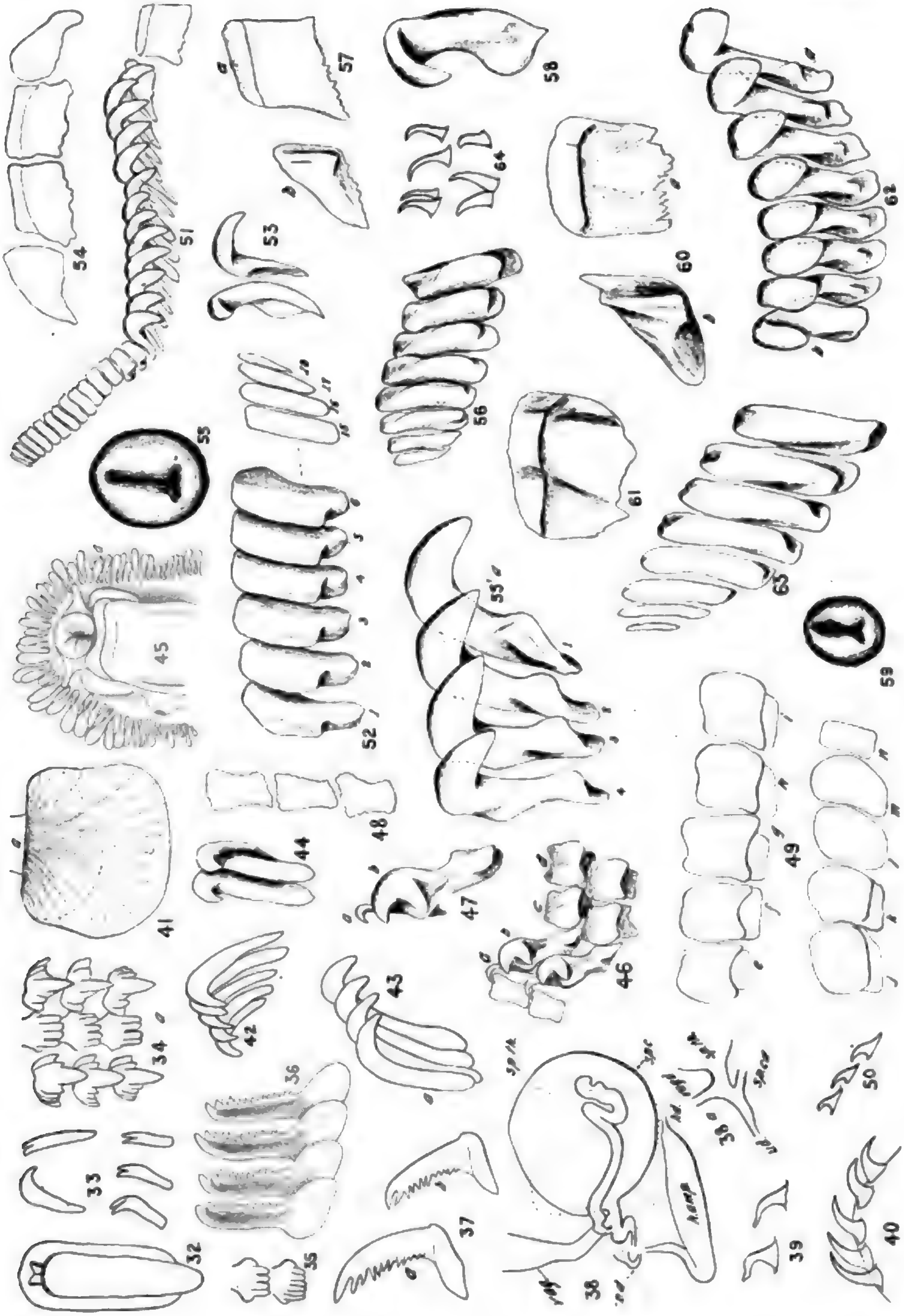
38 a
55 a

PLATE XX.

Polycera atra MacFarland.

FIG. 65.—Ventral view of anterior end of animal.
FIG. 66.—Outer face of mandibles. × 36. (Cam.)
FIG. 67.—Inner face of mandibles from behind. × 36. (Cam.)
FIG. 68.—Longitudinal median section through front of mandibles along line *a-b* of figure 66. × 60. (Cam.)
FIG. 69.—Fourth row of radula. × 83. (Cam.)
FIG. 70.—Uncinal plates, the outermost rudimentary. × 83. (Cam.)
FIG. 71.—Armature of glans penis. × 400. (Cam.)
FIG. 72.—Front view of cutting edges of mandibles. × 36. (Cam.)

Acanthodoris hudsoni MacFarland.

FIG. 73.—Ventral view of anterior end of animal. × 2.
FIG. 74.—Side view of labial armature. × 36. (Cam.)
FIG. 75.—Side view of blade-like processes at ventral portion of labial armature. × 120. (Cam.)
FIG. 76.—Dorsal view of blade-like processes of labial armature. × 146. (Cam.)
FIG. 77.—Inner face first pleural teeth of second and third rows. × 83. (Cam.)
FIG. 78.—Outer pleuræ shown in their relative position to the tip of the first pleural tooth. × 212. (Cam.)
FIG. 79.—Isolated hooks of labial armature. × 263. (Cam.)
FIG. 80.—*v. d.*, vaginal duct, *gl.*, its glandular portion; *a.*, its proximal loop; *sp. th.*, spermatotheca; *sp. c.*, spermatocyst; *u. d.*, uterine duct.

Acanthodoris brunnea MacFarland.

FIG. 81.—Labial armature obliquely from in front, with ventral blade-like process. × 52. (Cam.)
FIG. 82.—Dorsal view of blade-like process. × 120. (Cam.)
FIG. 83.—Elements of labial armature, *a*, in side view; *b*, pointed hook; *c*, blunt hook.
FIG. 84.—First pleural teeth of ninth and tenth rows. × 83. (Cam.)
FIG. 85.—Second pleural tooth. × 212. (Cam.)
FIG. 86.—Third pleural tooth. × 212. (Cam.)
FIG. 87.—Outer pleural teeth. *a*, third; *b*, ninth. × 212. (Cam.)
FIG. 88.—Reproductive organs from above. *vag.*, vagina; *p.*, penis; *v. def.*, vas deferens; *h. amp.*, hermaphroditic ampulla; *sp. th.*, spermatotheca; *sp. c.*, spermatocyst; *u. d.*, uterine duct. × 10. (Cam.)
FIG. 88*a*.—Relations of vaginal duct (*vag.*), uterine duct (*u. d.*), spermatocyst (*sp. c.*), and spermatotheca (*sp. th.*) from below. × 10. (Cam.)

Ancula pacifica MacFarland.

FIG. 89.—Ventral view of head of animal.
FIG. 90.—Elements of labial armature. × 212. (Cam.)
FIG. 91.—Upper end of labial armature. × 212. (Cam.)
FIG. 92.—Median plates of radula.

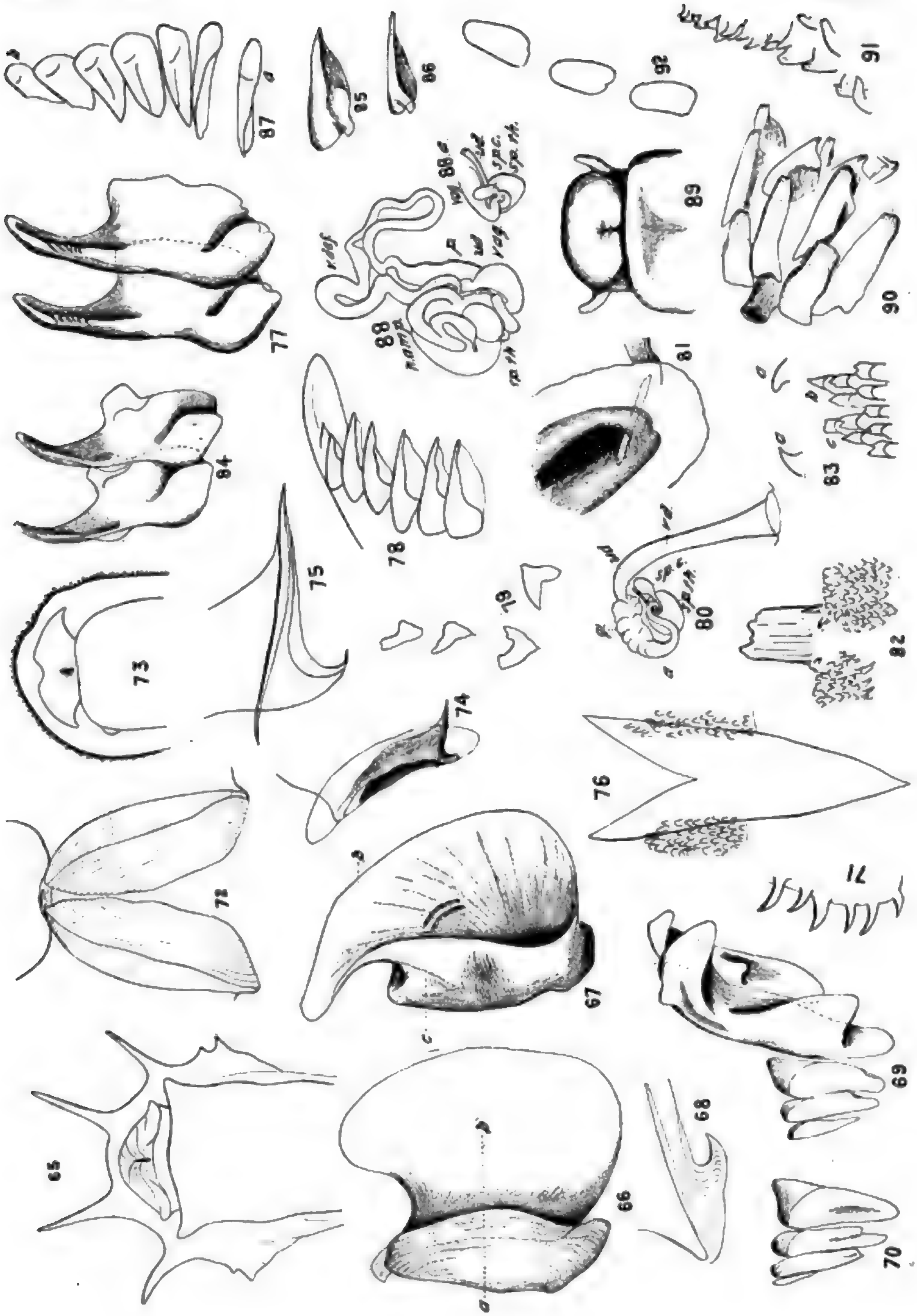
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PLATE XXI.

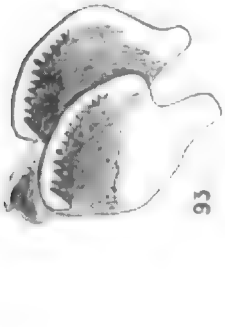
Ancula pacifica MacFarland.

FIG. 93.—Pleural teeth from within. × 268. (Cam.)
FIG. 94.—Anterior end of radula from above. × 225. (Cam.)
FIG. 95.—Second pleuræ obliquely from above. × 400. (Cam.)
FIG. 96.—Second pleuræ from within. × 400. (Cam.)

Hopkinsia rosacea MacFarland.

FIG. 97.—Variously branched dorsal papillæ. × 2.
FIG. 98.—Rhinophore in side view.
FIG. 99.—Armature of labial disk. *a*, Outer margin. × 212. (Cam.)
FIG. 100.—*a*, First pleural tooth from middle of radula, inner face; *b*, worn pleural tooth from anterior end of radula; *c*, second pleural tooth displaced. × 60. (Cam.)
FIG. 101.—First pleural tooth, outer face. × 60. (Cam.)
FIG. 102.—Second pleural tooth in side view. × 260. (Cam.)
FIG. 102*a*.—Second pleural tooth from above. × 260. (Cam.)
FIG. 103.—Reproductive organs from above and in front; *p*, penis; *v. d.*, vas deferens; *pr. gl.*, prostate gland; *vag.*, vagina; *sp. th.*, spermatotheca; *sp. c.*, spermatocyst; *u. d.*, uterine duct; *h. amp.*, hermaphroditic ampulla; *n. gl.*, nidamental gland. × 6. (Cam.)

FIG. 104.—*Acanthodoris brunnea* MacFarland. Rhinophore in front view.
FIG. 105.—*Polycera atra* MacFarland. Reproductive organs in part. *p.*, penis; *amp.*, ampulla of vas deferens; *vag.*, vagina; *sp. th.*, spermatotheca; *sp. c.*, spermatocyst; *u. d.*, uterine duct. × 6. (Cam.)
FIG. 106.—*Triopha maculata* MacFarland. Ventral view of anterior end of body.
FIG. 107.—*Triopha maculata* MacFarland. Dorsal view of oral tentacle.
FIG. 108.—*Triopha carpenteri* (Stearns). Ventral view of anterior end of body; *a*, dorsal view of oral tentacle.
FIG. 109.—*Rostanga pulchra* MacFarland. Ventral outline view of anterior end of body.
FIG. 110.—*Cadlina flavomaculata* MacFarland. Single plume of branchiæ.
FIG. 111.—*Polycera atra* MacFarland. 7th row of radula. × 52. (Cam.)
FIG. 112.—*Aldisa sanguinea* (Cooper). Reproductive system from front. *sp. th.*, spermatotheca; *sp. c.*, spermatocyst; *pr. gl.*, prostate gland; *h. amp.*, hermaphroditic ampulla; *v. def.*, vas deferens; *vag.*, vagina. × 14. (Cam.)
FIG. 113.—*Triopha carpenteri* (Stearns). Reproductive system (anterior genital mass) from front. *sp. th.*, spermatotheca; *sp. c.*, spermatocyst; *pr. gl.*, prostate gland; *v. def.*, vas deferens; *amp.*, ampulla of vas deferens; *p.*, penis; *nid. gl.*, nidamental gland. × 7. (Cam.)
FIG. 114.—*Aldisa sanguinea* (Cooper). Part of glans penis armature. × 390. (Cam.)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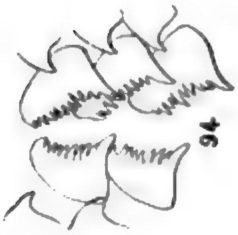
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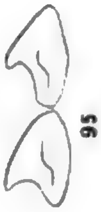
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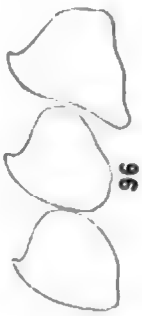
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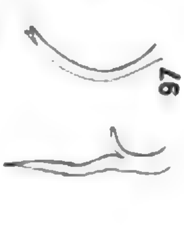
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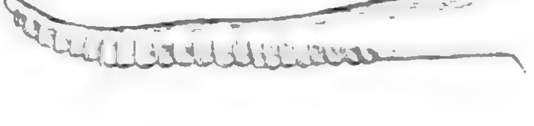
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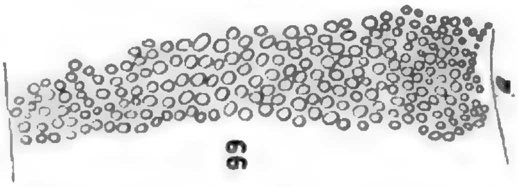
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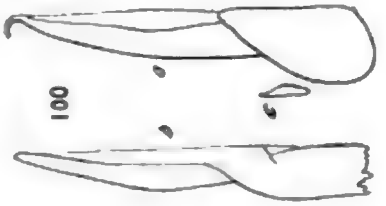
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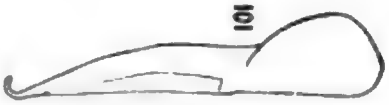
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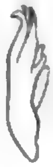
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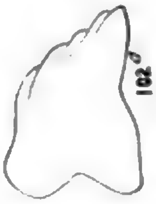
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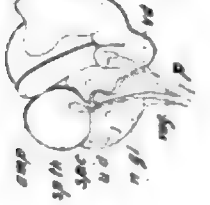
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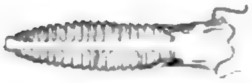
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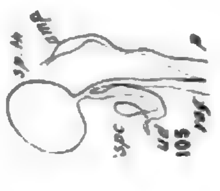
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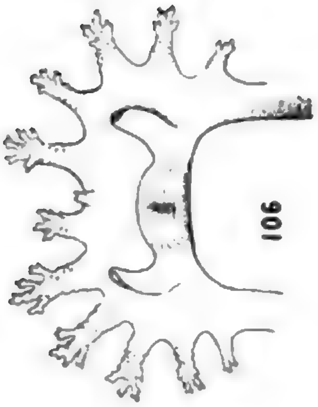
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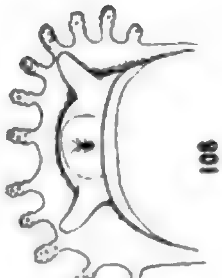
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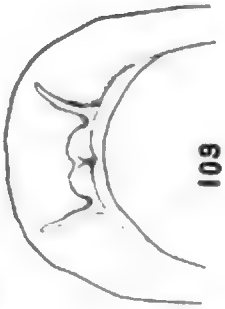
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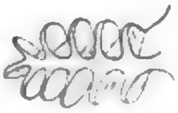
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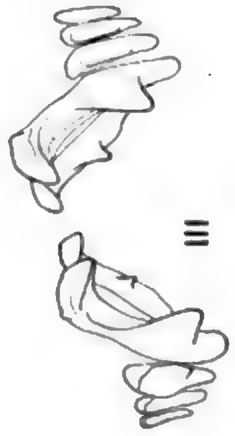
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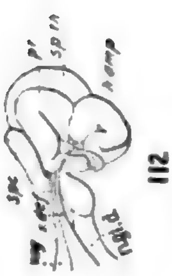
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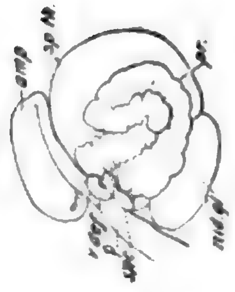
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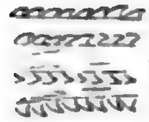
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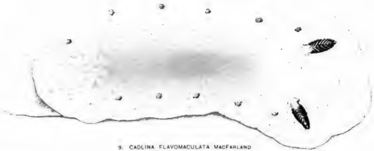
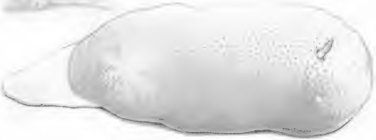


9. CADLINA FLAVOMACULATA MACFARLAND
Dorsal view, 10 times natural size

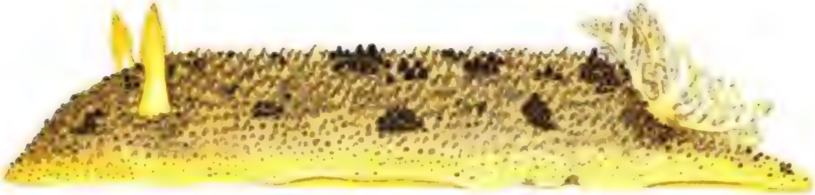
10 AND 11. CADLINA MARGINATA MACFARLAND
Ventral view, 2.8 times natural size
Detail of dorsum greatly enlarged



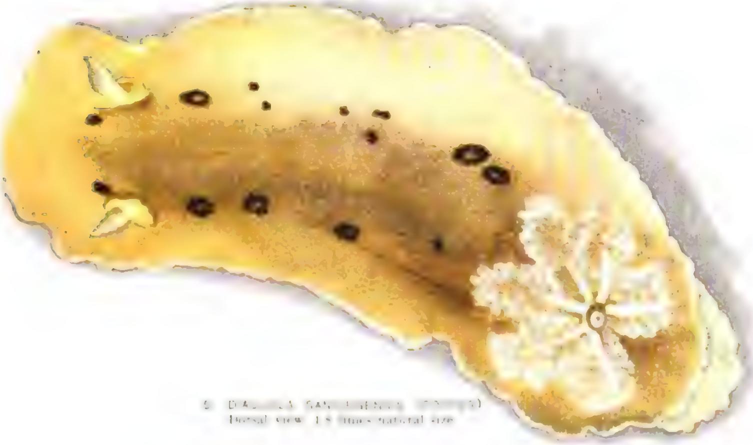
12. CADLINA MARGINATA MACFARLAND
Dorsal view, 2.8 times natural size

A. HOEN & CO., LITH.

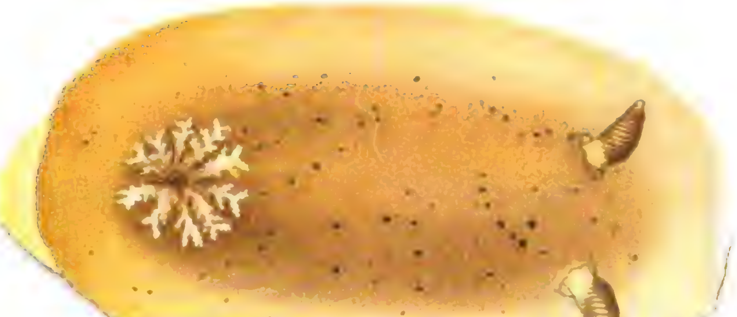
Google



4. ARCHIDORIS MONTEREYENSIS (COOPER)
Lateral view, twice natural size

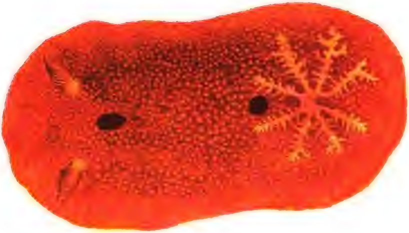


5. DIAULULA SANDIEGENSIS (COOPER)
Dorsal view, 1.5 times natural size

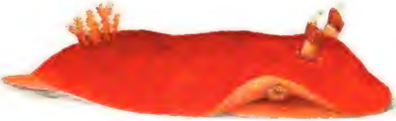


6. DISCODORIS HEATHI MACFARLAND
Dorsal view, 10 times natural size

A. HOEN & CO., LITH.

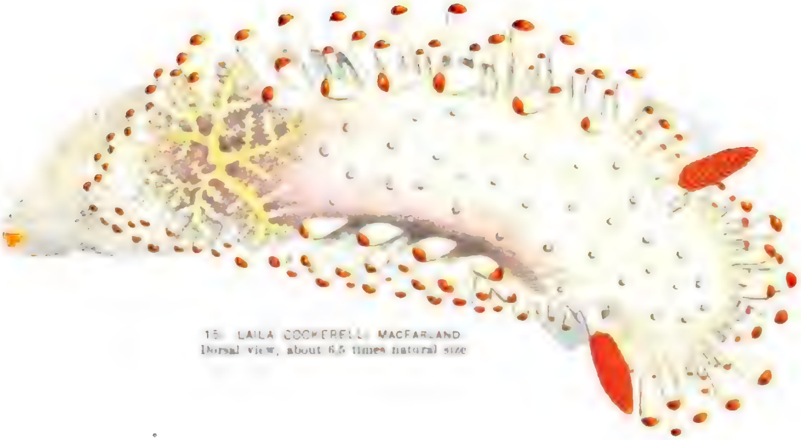


7. ALDISA SANGUINEA (COOPER)
Dorsal view, 7 times natural size

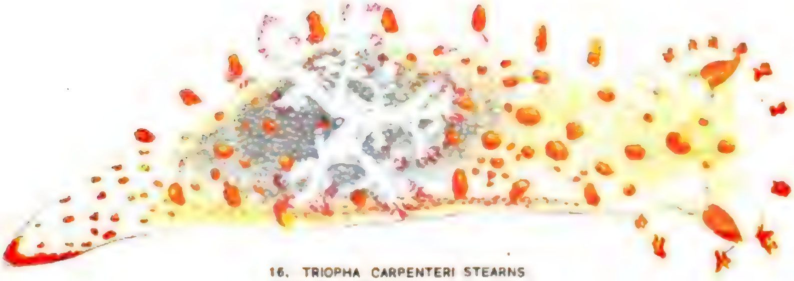


8. ROSTANGA PULCHRA MACFARLAND
Lateral view, 10 times natural size

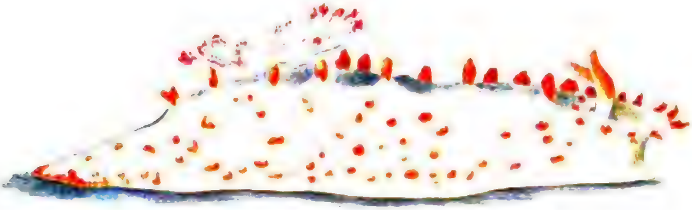
A. HOEN & CO., LITH.



15. LAILA COCKERELLI MACFARLAND
Dorsal view, about 6.5 times natural size

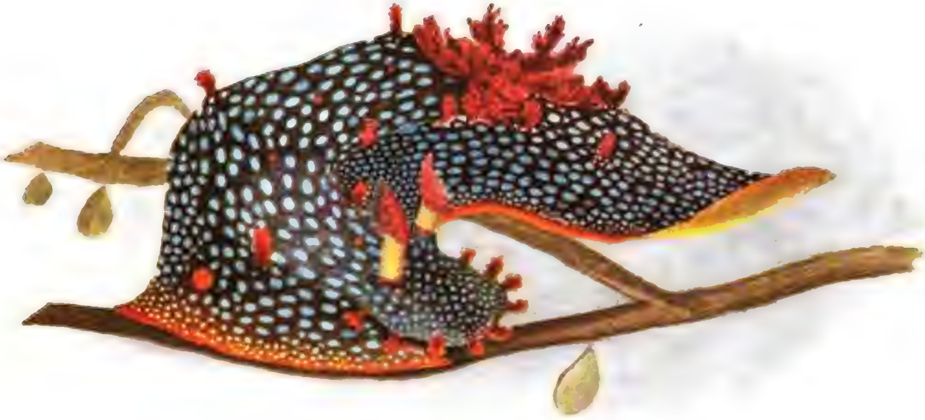


16. TRIOPHA CARPENTERI STEARNS
Dorsal view, about 1.5 times natural size

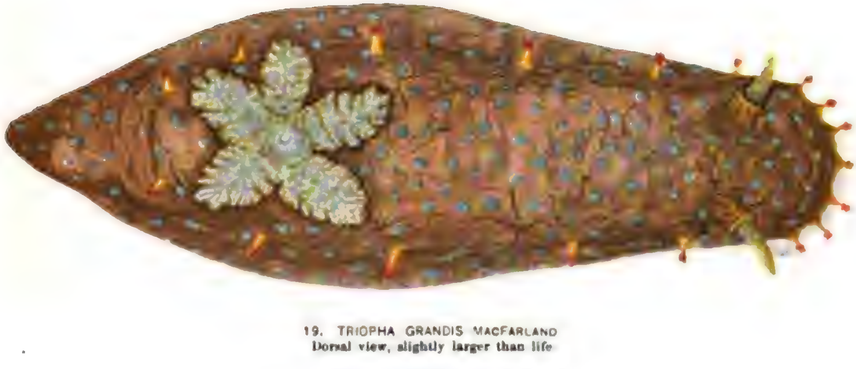


17. TRIOPHA CARPENTERI STEARNS
Lateral view, about 1.5 times natural size

A. HOEN & CO., LITH.

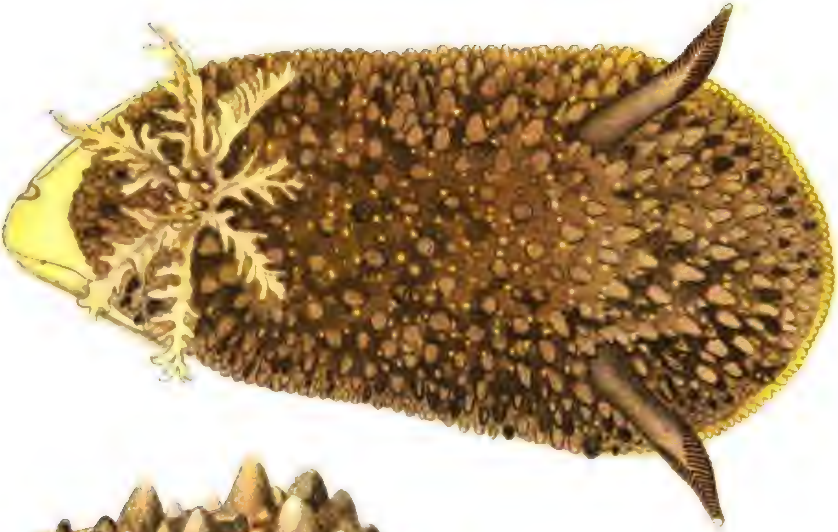


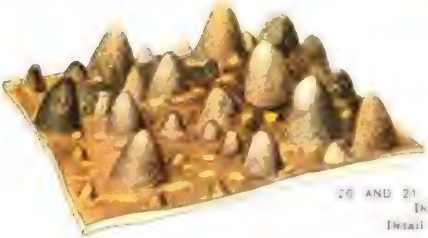
18. TRIOPHA MACULATA MACFARLAND
Dorso-lateral view, about 1.5 times natural size



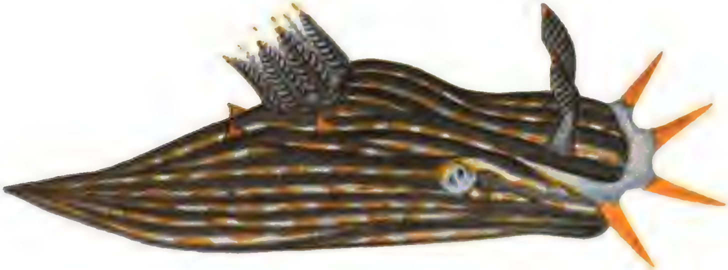
19. TRIOPHA GRANDIS MACFARLAND
Dorsal view, slightly larger than life

A. HOEN & CO., LITH.



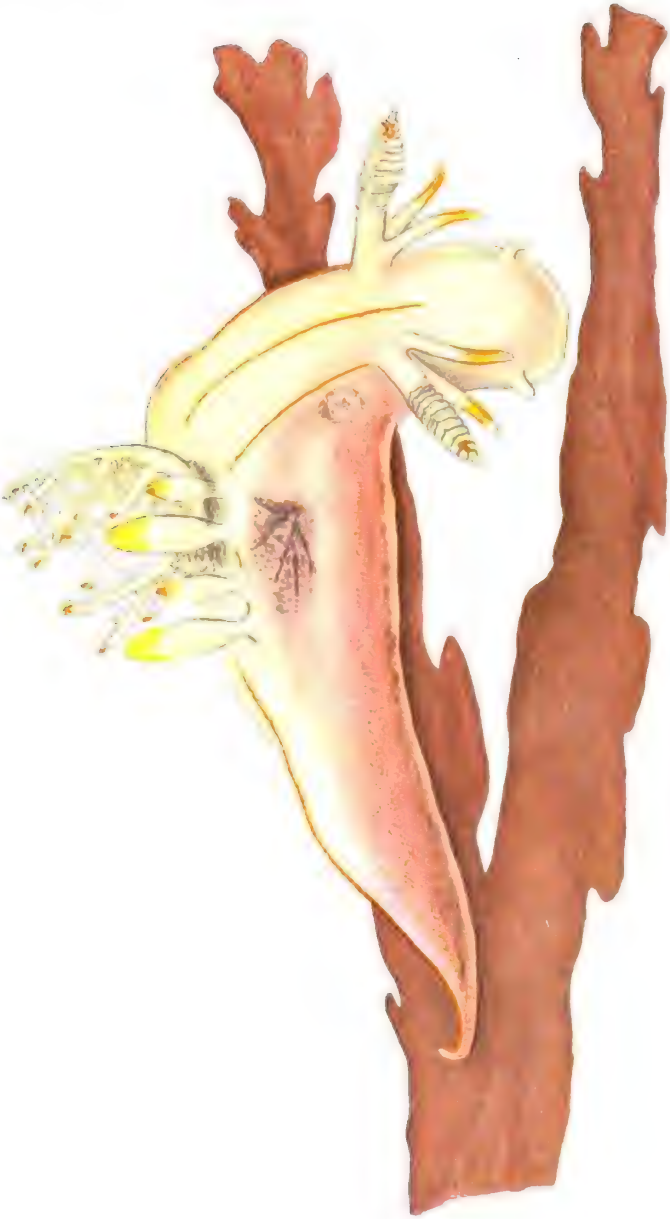


20 AND 21. ACANTHODORIS BRUNNEA MACFARLAND.
Dorsal view, 6 times natural size
Detail of dorsal papillæ, greatly enlarged



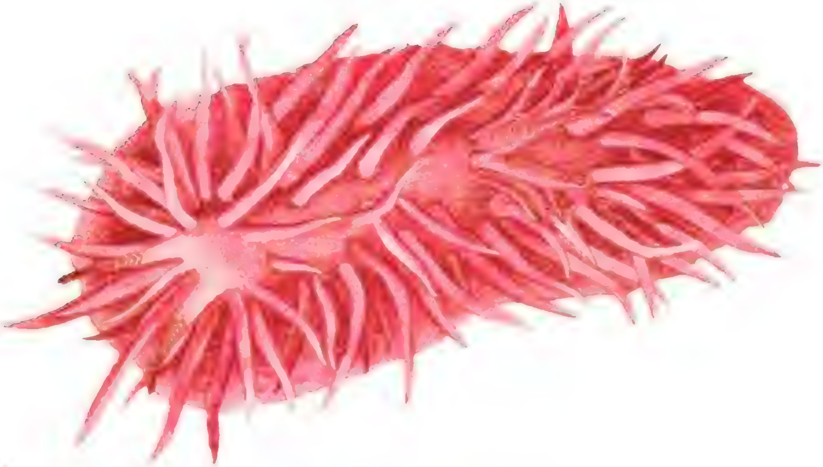
22. POLYCERA ATRA MACFARLAND
Lateral view, 5 times natural size

A. HOEN & CO., LITH.

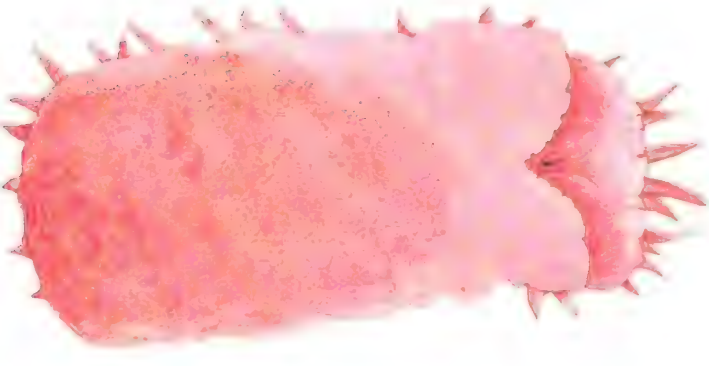


23. ANCULA PACIFICA MACFARLAND
Dorso-lateral view, about 10 times natural size

A. HOEN & CO., LITH.



24. HOPKINSIA ROSACEA MACFARLAND
Dorsal view, 5 times natural size



25. HOPKINSIA ROSACEA MACFARLAND
Ventral view, 5 times natural size

A. HOEN & CO., LITH.

CONTRIBUTIONS TO THE BIOLOGY OF THE GREAT LAKES.

HIRUDINEA AND OLIGOCHÆTA COLLECTED IN THE GREAT LAKES REGION.

By J. PERCY MOORE, Ph. D.

CONTRIBUTIONS TO THE BIOLOGY OF THE GREAT LAKES.

HIRUDINEA AND OLIGOCHÆTA COLLECTED IN THE GREAT LAKES REGION.

By J. PERCY MOORE, Ph. D.

I. HIRUDINEA.

The operations of the field parties directed by Prof. Jacob Reighard in connection with the biological survey of the Great Lakes yielded a large number of carefully preserved and labeled leeches, the detailed study and identification of which have required considerable time and furnished interesting data on variation that can be more profitably utilized elsewhere than in this report. The bulk of the collection comes from the western end of the lake, where a few specimens were collected in the vicinity of Put-in Bay during the summer of 1898, and a great many at the same place, at other points about the Bass Islands, at Sandusky, and along the Canadian and Ohio shores during the following summer; in the latter season also smaller collections were taken at Erie, Pa., and other places in eastern Lake Erie. As no systematic collecting seems to have been done in the small lakes, ponds, and creeks in which the large, jawed leeches abound, no representatives of the family Hirudinidæ are included; nor was any attempt made to gather the fish leeches, and the single vial containing Ichthyobdellidæ unfortunately met with an accident that prevents the determination of its contents.[a] On the other hand, the shore collecting was very thorough, and the families Glossiphonidæ and Herpobdellidæ are probably represented by every species found in such situations in Lake Erie, and in most cases by many beautifully preserved specimens. Several carefully executed water-color sketches from life, prepared by Mrs. H. S. Jennings, which are herewith published, and some notes on the living colors accompany the collection and furnish valuable data. The determination of some of the species of Glossiphonidæ is especially difficult and requires the most minute study of both internal and external features of their organization in all stages of growth and development, at different seasons, and under different nutritive conditions.

While this and other large collections studied in recent years have materially advanced the writer's knowledge in this direction, much yet remains to be done before the limits of variation and the correlations of characters can be finally defined for some of our species. Owing to the considerable attention that leeches of this family from the eastern and northern states have recently received, it is not surprising that but a single species has been added to those previously known, and it has not been thought necessary to include detailed descriptions of any others, though a key is added which will serve for typical examples, at least. Complete descriptions with figures, some of them colored, will be found in a report on the leeches of Minnesota prepared by the writer and soon to be published by the Natural History Survey of Minnesota. Some additional information will be found in Castle, North American Fresh-water Rhynchobdellidæ (Bulletin Museum Comparative Zoology, 1900), and Moore, Hirudinea of Illinois (Bulletin Illinois State Laboratory of Natural History, 1901), and in the papers therein cited. A full catalogue of the localities at which each species was taken is given, the station number being included in parentheses and followed by such data as the labels afford.

---

[a] A later systematic examination of the food fishes of Lake Erie shows that they are remarkably free from leeches.

Key to the species of leeches contained in this collection.

I. Mouth a small pore in the disk of the anterior sucker from which a muscular pharyngeal proboscis may be protruded; eyes all situated close to the middle line.

a. Complete somites of 3 annuli, with the secondary furrows altogether wanting or only very slightly developed.

b. Genital pores separated by a single annulus; eyes simple, 1 pair, widely separated.

c. A brown chitinoid plate and underlying gland situated on the dorsum of somite VIII.

d. Body capable of great extension; no distinct cutaneous papillæ; color pale, pink, gray, or brownish; gastric cæca small and variable in number, never more than 6 pairs.
Glossiphonia stagnalis (p. 157).

cc. No nuchal gland nor plate.

e. Body greatly elongated, slender and nearly terete, without cutaneous papillæ and very transparent, owing to the nearly complete absence of pigment; gastric cæca only 1 pair.
Glossiphonia nepheloidea (p. 158).

ee. Body relatively broad and flat; cutaneous papillæ absent or in 1 to 5 rows, which may be very small or very large and often double; deeply pigmented, usually longitudinally striped or with metameric white spots on the neural annuli; gastric cæca always 6 pairs, of moderate size and simple form.................. *Glossiphonia fusca* (p. 158).

bb. Genital pores separated by 1 annulus; 3 pairs of simple eyes grouped in twos in a more or less triangular figure.

f. Body very thin, broad, and flat; no distinct cutaneous papillæ; integument transparent and pigment nearly absent; gastric cæca 6 pairs, of moderate size and nearly or quite unbranched .... *Glossiphonia heteroclita* (p. 159).

bbb. Genital pores separated by 2 annuli; 3 pairs of simple eyes in 2 nearly parallel rows.

g. Body relatively broad and short; cutaneous papillæ low and rounded, no median series; usually deeply pigmented and having a pair of narrow dark longitudinal lines reaching from the eyes to the posterior end; gastric cæca 7 pairs, of moderate size and slightly branched .... *Glossiphonia complanata* (p. 159).

bbbb. Genital pores separated by 2 annuli; a single pair of compound eyes more or less completely united in a single pigment mass; gastric cæca 7 pairs, of large size and much branched; salivary glands compact.

h. Somites I to V distinctly widened to form a discoid "head."

i. Somites I and II biannulate; dorsum marked by 3 strong papillated keels.
Placobdella montifera (p. 160).

hh. Anterior somites (I to V) not especially widened.

j. Body very much depressed; the cutaneous papillæ low and smooth; integuments opaque, and the color a conspicuous pattern of some shade of olive green and yellow, below longitudinally striped; *a2* more closely united to *a1* than to *a3* on all anterior somites; *a3* without trace of a secondary furrow; size large .... *Placobdella parasitica* (p. 159).

jj. Much depressed, with very inconspicuous, low and smooth papillæ; integuments translucent and not deeply pigmented, usually striped longitudinally below; the union of *a1* and *a2* not especially conspicuous; the annulus *a3* with a distinct incomplete cross furrow on all complete somites; size medium .... *Placobdella picta* (p. 159).

jjj. Much depressed, the back with very numerous papillæ, the largest of which are very prominent and rough; integuments translucent; colors a mixture of browns, greens, and yellows founded on a much broken longitudinal pattern, often longitudinally striped below; *a3* not subdivided and the dorsal and ventral furrows not accurately meeting; size large. *Placobdella rugosa* (p. 160).

jjjj. Moderately depressed, with more or less numerous and roughened papillæ; integuments translucent; colors variable, much as in the last, but brighter and with more dark pigment on the neural annulus and a more constant median dorsal dark stripe, interrupted by 5 or 6 pale spots; differs from all other species of this key in the several pairs of accessory eyes which follow the compound ones; size medium .... *Placobdella hollensis* (p. 160).

jjjjj. Not greatly depressed, rather slender anteriorly; cutaneous papillæ usually in a median and one paired series, small, acute, and pale yellow or brown; color pattern chiefly longitudinal brown and green stripes, interrupted by light areas; a very conspicuous and constant pale band across the entire width of somite VI; differing from all similar foregoing species in the circle of small papillæ on the margin of the caudal sucker; size small .... *Placobdella phalera* (p. 160).

aa. Complete somites of 6 unequal annuli formed by the subdivision of the 3 primary rings.

k. Three series of prominent dorsal papillæ; caudal sucker large and mobile, with a circle of about 60 marginal papillæ and glands ....*Actinobdella annectens* (p. 160).

II. Mouth relatively large, occupying the entire cavity of the anterior sucker; the pharynx not forming a protrusible proboscis; eyes partly situated on the sides of the head; somites of 5 annuli.

l. Annulus *b6* not obviously enlarged and subdivided.

m. Eyes 3 pairs; male pore at XII *b2/a2*; female pore at XII *b5/b6*; the vas deferens forming a loop reaching forward of the atrium to ganglion XI .... *Erpobdella punctata* (p. 163).

ll. Annulus *b6* distinctly longer than the others and subdivided into two.

n. Eyes 3 pairs; male pore at XII *b2/a2*; female pore at XII/XIII; the atrial cornua inconspicuous and passing abruptly into the vas deferens which lacks the anterior loop ... *Dina microstoma* (p. 163).

nn. Eyes 3 or 4 pairs; genital orifices as in *m*; the atrial cornua prominent and the vasa deferentia without anterior loops.
Dina fervida (p. 163).

GLOSSIPHONIDÆ.

Glossiphonia stagnalis (Linnæus).

Abundant everywhere in shallow waters, but especially so at Erie, Pa. Examples from Sandusky, Ohio, bearing young to the middle of August. (Pl. XXXII, fig. 2.)

(90*a*) Lemna Pond, South Bass Island, Ohio, July 5, 1899.

(95*a* and 96*a*) North Bass, Swamp, Put-in Bay, Ohio, July 21, 1899. The commensal ciliate that lives attached to the nuchal gland of this species occurs in particularly luxuriant colonies on these specimens.

(111) Pond near Hatchery, South Bass Island, Ohio, August 18, 1898.

(111*a*) Middle Bass, Ohio, North Swamp, July 24, 1899.

(115) South Bass Island, Ohio, swamp near East Point, August 24, 1899.

(125*a*) East Harbor, Sandusky, Ohio, July 28, 1899; a single unusually large example.
(127) Shore of South Bass Island, Ohio, September 10, 1898.
(179*a*) East Harbor, Ohio, near Lakeside, August 4, 1899; from flag leaves.
(192*a*) East Harbor, Sandusky, Ohio, August 7, 1899; from wild rice.
(209*a*) East Harbor, Sandusky, Ohio, August 9, 1899.
(268*a*) Erie, Pa., north shore, on logs, August 14, 1899.
(313*a*) Long Pond, Erie, Pa., August 15, 1899.
(365*a*) Long Point, Canada, August 21, 1899.
(380*a*) Long Point, Canada, August 21, 1899; 1 specimen taken from a rock bass.
(459*a*) Rondeau Harbor, Ontario, from East Swamp, August 28, 1899.

Glossiphonia nepheloidea (Graf).

This species, which is fully described by Castle under the name of *G. elongata*, is represented by but 3 specimens from (67) Put-in Bay, Ohio, August 12, 1898 (under rocks); (266*a*) Erie, Pa., Graveyard Swamp, August 14, 1899 (from stones and rocks). Two examples from the latter locality are very greatly elongated.

Glossiphonia fusca Castle.

The earliest name given to any of the varieties included under this species is *Clepsine papillifera lineata* Verrill, but as the prior *Hirudo lineata* Müller is almost certainly *Glossiphonia complanata*, and R. Blanchard has shown that the closely related *G. triserialis* E. Blanchard differs in the position of the male genital pore, Castle's name becomes the earliest available. *G. fusca* is the most variable of our *Glossiphoniæ*, and the extremes are so unlike that were they alone in hand no hesitation would be felt in arranging them in two or three distinct species, and it is possible that further study may lead to the recognition of two. The large number of specimens, amounting to between 200 and 300, belonging to the present and other collections that have been carefully studied show that the extremes in color pattern, papillation, size of salivary glands and gastric cæca, length of the stalks of the nephridial funnels, and the degree of development of the cœlomic sinuses are connected by a more or less complete series of gradations. It has not yet been found possible to fully correlate the occurrence of these and other characters, but three well-marked types or varieties may be distinguished: One, having the nearly uniform ground color and metameric white spots of the typical *fusca* as described by Castle, includes most of the smaller nonpapillated individuals; another has a sharply defined longitudinally striated pattern (pl. XXXII, fig. 5) with 1 or 3 rows of small, usually deeply pigmented papillæ like the form figured by Graf under the designation of *Clepsine b;* some of the smaller and most of the medium sized specimens are of this variety; in the largest examples the body tends to become more elongated, flatter, and thinner, and most of the brown pigment becomes concentrated in five or seven rows of exceedingly large papillæ, many of which are double. The eyes are relatively farthest apart, the first pair of gastric cæca small or absent, and the cœlomic spaces best developed in the small, typical *fusca*, while the opposite extremes in these features are likely to occur in the largest and most strongly papillated forms. In all of the three or four examples of each variety sectioned the stalks of the nephridial funnels are longer in the *lineata* than in the *fusca* type, but not noticeably different from those of the strongly papillated variety. All three forms are well represented in the collection and are separated, though sometimes perhaps arbitrarily, in the following list:

TYPICAL FUSCA TYPE.

(103) Sandusky Bay, Ohio, August 18, 1898.
(268*a*) Erie, Pa., north shore, August, 1899; from logs near shore.
(269*a*) Erie Bay, Pennsylvania, August 14, 1899.
(314*a*) Boat Harbor, Erie, Pa., August 16, 1899; from *Ceratophyllum*.
(343*a*) Long Point, Canada, August 18, 1899.
(457*a*) Rondeau Harbor, Ontario, August 28, 1899.

LINEATA TYPE.

(180*a*) East Harbor, Sandusky, Ohio, near Lakeside, August 4, 1899; from flags.
(209*a*) East Harbor, Sandusky, Ohio, August 9, 1899.
—— Huron, Ohio, August 10, 1899.
(269*a*) Erie, Pa., north shore of Erie Bay, August 14, 1899.
(307*a*) Erie, Pa., boat landing, August 16, 1899; from *Sagittaria*.
(314*a*) Boat Harbor, Erie, Pa., August 16, 1899; from *Ceratophyllum*.
(327*a*) Long Point, Canada, August 18, 1899.
(365*a*) Long Point, Canada, August 21, 1899.
(456*a*, 459*a*, 460*a*) Rondeau Harbor, Ontario, East Swamp, August 28, 1899. One specimen only 4 mm. long has the longitudinally striated pattern very strongly developed.

STRONGLY PAPILLATED TYPE.

(200*a*) East Harbor, Sandusky, Ohio, August 8, 1899.
(325*a*, 343*a*) Long Point, Canada, August 18, 1899.
(457*a*, 460*a*) Rondeau Harbor, Ontario, East Swamp, August 28, 1899.

Glossiphonia complanata (Linnæus) Johnston.

A common species. (Pl. XXXII, fig. 4.)
(40*a*, 109*a*) Middle Bass Island, Ohio, North Swamp, July 24, 1899.
(92*a*) North Bass Swamp, Put-in Bay, Ohio, July 21, 1899.
(125*a*) East Harbor, Sandusky, Ohio, July 28, 1899.
(178*a*) East Harbor, Sandusky, Ohio, near Lakeside, August 4, 1899; from flag leaves.
(326*a*) Long Point, Canada, August 18, 1899.
(365*a*) Long Point, Canada, August 21, 1899.
(380*a*) Long Point, Canada, August 23, 1899; from rock bass.
(439*a*) Rondeau Harbor, Ontario, August 28, 1899; East Swamp.

Glossiphonia heteroclita (Linnæus).

This species is either rare in Lake Erie or, on account of its small size and pale color, was overlooked. It was collected in small numbers at but three localities.
(268*a*) Erie, Pa., August, 1899; from logs on north shore.
(327*a*) Long Point, Canada, August 18, 1899.
(459*a*) Rondeau Harbor, Ontario, August 28, 1899; from East Swamp.

Placobdella picta (Verrill).

Taken only in the western end of the lake. The length and distinctness of the median light stripe vary greatly. (Pl. XXXII, fig. 3.)
(33*a*) South Bass Island, East Swamp, July 10, 1899.
(91*a*, 92*a*) Put-in Bay, Ohio, North Bass Swamp, July 21, 1899.
(110*a*) Middle Bass Island, Ohio, Middle Swamp, July 24, 1899.
(109*a*) Middle Bass Island, Ohio, North Swamp, July 24, 1899.
—— East Haven, Sandusky, Ohio.

Placobdella parasitica (Say).

Nearly all of the examples of this species were taken from snapping turtles; one very large one in the bottom tow (39*a*).
(9*a*) South Bass Island, Ohio, Lemna Pond, July 5, 1899.
(39*a*) Put-in Bay, Ohio, July 15, 1899; bottom tow.
(77*a*) Put-in Bay, Ohio, July 17, 1899.
(97*a*) North Bass Island, July 20, 1899; from carapace of turtle.
(135) Put-in Bay, Ohio, Squaw Bay, September 13, 1898.

(137*a*) Sandusky, Ohio, East Harbor, July 28, 1899.
(345*a*, 346*a*) Long Point, Canada, August 19, 1899.
(440*a*) Rondeau Harbor, Ontario, East Swamp, August 28, 1899.

Placobdella rugosa (Verrill).

This common and variable species is widely distributed and occurs either free or parasitic on fishes and turtles.

(8*a*) South Bass Island, Ohio, Lemna Pond, July 6, 1899.
(10*a*) South Bass Island, Ohio, Lemna Pond.
(44) South Bass Island, Ohio, August 16, 1898; on sticks near hatchery.
(92*a*) Put-in Bay, Ohio, North Bass Swamp, July 21, 1899.
(210a) West Harbor, Ottawa County, Ohio, August 8, 1899; on *Planorbis*.
(267*a*) Erie, Pa., Graveyard Swamp, August 14, 1899.
(343*a*) Long Point, Canada, August 18, 1899.
(380*a*) Long Point, Canada, August 23, 1899; from rock bass.
(403*a*) Long Point, Canada, September 24, 1899.
—— Huron, Ohio, August 10, 1899.

Placobdella hollensis (Whitman).

A single specimen colored exactly on the pattern of Graf's figure and with typical annulation and eyes was taken at East Swamp, Rondeau, Ontario, August 28, 1899.

Many examples of this species are provided with cutaneous papillæ almost as large and rough as those of *P. rugosa*, and it is often difficult to assign examples to one or the other species. Generally the eyelike character of the anterior dorso-median sensillæ is sufficient and this species is seldom so broad and flat, nor is the lack of agreement of the dorsal and ventral furrows so evident as in *P. rugosa*.

Placobdella montifera nom. nov.

This is the species known in my paper on the Hirudinea of Illinois as *Hemiclepsis carinata* (Verrill). The resemblance to one species of *Hemiclepsis* is entirely superficial and the name *carinata* has been already used by Grube for a species of this genus, requiring that a new one be coined. In the character of its papillation, the incipient subdivision of its annuli, and the papillæ of the posterior sucker, which are very small and number 110 or more, this species approaches *Actinobdella*. The form of the broadly expanded head is, however, distinctive of it among the known species of leeches of North America.

(379*a*) Long Point, Canada, August 28, 1899; from rice grass.
(403*a*) Long Point, Canada, September 24, 1899.

Placobdella phalera (Graf).

Several specimens of a small leech which is rather doubtfully referred here conform closely with Graf's account of the arrangement of pigment, reserve cells, and other features of *P. phalera*. Two of the most striking characters of the species are the strongly developed band of reserve cells, appearing on the surface as a white or pale-yellow stripe, which extends entirely across the neck at somite VI, and the serrated margin of the posterior sucker, which has a circle of small papillæ as in *Actinobdella annectens*, but lacks the definite aggregated glands.

(178*a*) East Harbor, near Lakeside, Ohio, August 4, 1899; from flag leaves.
(196*a*) East Harbor, Sandusky, Ohio, August 7, 1899.
(324*a*) Long Point, Canada, August 16, 1897.

Actinobdella annectens sp. nov. (text figs. 1 and 2).

Most interesting of the leech collections is a specimen, fortunately well preserved, of a new species of *Actinobdella* which, together with an example of *A. inequiannulata* described in the Report on the Leech Fauna of Minnesota, clearly shows that this genus belongs to the Glossiphonidæ and not to the Ichthyobdellidæ as I was erroneously led to suppose from a knowledge of the superficial characters alone of the type. Much is yet lacking in our knowledge of the organization of these interesting leeches, but it is hoped that a complete account of their anatomy can soon be published. At the present time it seems evident that *Actinobdella* approaches *Placobdella* most closely, especially in the character of the reproductive organs, gastric cæca, and sense organs, while it differs from that genus and resembles *Glossiphonia* in the possession of diffuse instead of compact salivary glands. The fact that certain species of *Placobdella*, notably *P. phalera* and *P. montifera*, possess small marginal papillæ on the caudal sucker is a further indication of relationship which may eventually necessitate a generic grouping somewhat different from that here adopted.

A. annectens, like *A. inequiannulata*, is a small blood-sucking glossiphonid, the type of which is 9 mm. long, 2 mm. wide, and about 1 mm. high. The general form is much like that of *Glossiphonia fusca* but considerably more slender; the body is strongly convex above, flat below, the region of the gastric cæca about half round; the head end, with the sucker and mouth, have the typical glossiphonid form; and the thick, prominent, hemispherical caudal sucker measures 1.2 mm. in diameter and its pedicle is contracted and centrally attached, indicating great mobility in this region. The marginal papillæ of the caudal sucker form a ready means of distinction between this species and *A. inequiannulata*, for whereas the latter possesses about thirty very prominent papillæ, *A. annectens* has about sixty much smaller ones. They are unfortunately much contracted, but are clearly continuations of radiating ridges on the ventral surface of the sucker and have the same structure and relation to compact aggregated glands as in the type species. These glands form a conspicuous ring a short distance from the margin of the sucker, the dorsal surface of which they elevate into a circular ridge. In correspondence with the smaller and more numerous papillæ these glands differ from those of *A. inequiannulata*, and at places the continuity of the ring is interrupted by the absence of several together.

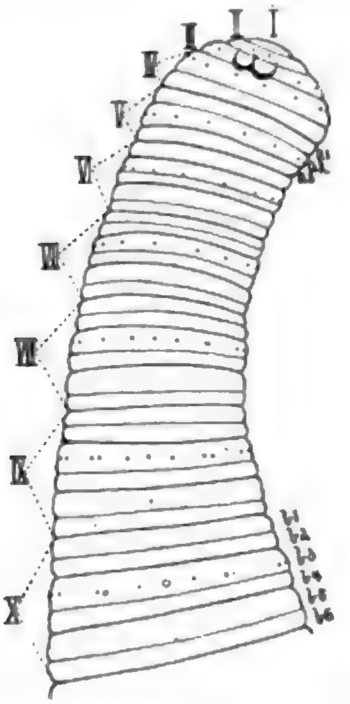


FIG. 1.—*Actinobdella annectens.* Annulation and sensillæ of anterior end. × 30.

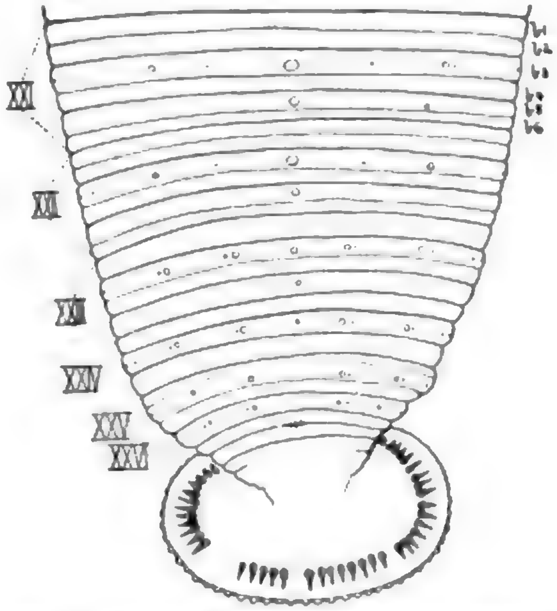


FIG. 2.—*Actinobdella annectens.* Posterior end showing annulation, sensillæ, posterior sucker, etc. × 30.

A single pair of very large and conspicuous eyes are situated on somite III, with their pigment cups in contact and united in the middle line and reaching into IV. Immediately behind the eyes is a large aggregation of reserve cells extending over the middle portion of somites IV and V and margined by pigment cells. A similar patch occurs on annuli VI *a*3 and VII *a*1, and others are distributed much as in *Placobdella phalera*. The position of the genital pores is quite as in *Placobdella*, the male orifice being situated between somites XI and XII and the female between the second and third primary annuli of XII. The anus is behind XXVI.

The metameric sensillæ are very obscure on the ventral but easily distinguished on the dorsal surface; they present quite the arrangement typical of the family. Dorsal cutaneous papillæ are also well developed from somites XIII to XXVI inclusive, and the larger ones may be traced faintly anterior of the genital somites as far forward as VI As in *A. inequiannulata* the strictly median series is by far the most conspicuous and dominant one and is represented on the complete and typical somites by a large papilla on the annulus *b*3 and a somewhat smaller one on *b*5. On XXIII these papillæ suddenly become reduced greatly in size and by XXV have disappeared, while rather prominent dorso-median papillæ are coincidently developed on each side and continue to XXVI. Dorso-lateral papillæ on *b*3 are nearly as constant but much smaller as far back as somite XXVI, and on many of the typical somites a corresponding but still smaller papilla occurs in a more median position on *b*5. It will be noticed that in the arrangement of the papillæ, as in so many other characters, this species stands between *A. inequiannulata* and *Placobdella montifera* and *P. phalera*.

In the manner of subdivision of typical somites into annuli this species closely follows the type of the genus. The first primary annulus (*a*1) is always much smaller than *a*2 or *a*3, and is completely subdivided into two short equal or nearly equal rings (*b*1 and *b*2); the primary neural annulus (*a*2) is divided into a larger anterior ring (*b*3), which bears the papillæ and metameric sensillæ and a much smaller posterior ring (*b*4); the third primary annulus (*a*3) is similar in size and mode of subdivision to the second, and its larger anterior annulus (*b*5) bears the papillæ, while the small *b*6 is naked. Somites VII to XXII are complete, although *a*3 is already much smaller than *a*2 even on XXI, and on XXII the furrow *b*5/*b*6 is not quite complete. On XXIII all secondary furrows are nearly absent and *a*3 is a small simple ring. On XXIV *a*1 is barely separated from *a*2; XXV and XXVI are typically biannulate, and several obscure annuli in the caudal pedicle represent postanal somites. The annulation of the anterior incomplete somites is very clear, and shows that elaboration has progressed farther in this species than in *A. inequiannulata*. Somite VI has *a*1 undivided, V is triannulate with *a*2 somewhat enlarged, IV is biannulate with the furrow *a*1/*a*2 indicated, III is a broad, practically undivided annulus, and II and I are simple and undivided. (See figs. 1 and 2.)

A few features of the internal anatomy may be noted. The probocis is slender and, as retracted in this specimen, reaches from XI to VIII. The salivary glands are of the diffuse type and open into the œsophagus in X or XI; they are greatly developed and densely packed by the sides of the alimentary canal as far forward as the anterior part of somite VIII. Exactly similar glands are developed in large numbers along the sides of the body to somite XXIV, but it is impossible to determine definitely in the entire leech to what extent these are salivary or clitellar and cutaneous glands. There are seven pairs of well-developed branched gastric cæca arising in somites XIII to XIX, inclusive, arranged as in *Placobdella*, though not so large and completely branched as in the broad flat species of that genus. The first pair have slender anterior lobes which reach forward by the sides of the reproductive organs to the anterior end of XII; the seventh pair reach backward beside the intestine to XXIII, with five lateral lobes in somites XIX to XXIII. The narrow and posteriorly somewhat tortuous intestine bears the usual four pairs of cæca crowded into three somites (XX to XXII). Although conforming to the general type of the reproductive organs of *Placobdella*, the male afferent ducts are more elongated and slender than in most species and reach to a sperm sac situated on the boundary between XII and XIII, being thus less compact and more open in arrangement than in most species of *Placobdella*. The greater part of the sinus system was worked out and found to conform in most respects to what is found in the Glossiphonidæ generally, one important characteristic being that the submarginal circular sinus of the posterior sucker is connected with the axial sinus behind the anus by 15 or 16 radiating canals. The type specimen (no. 5228, U. S. National Museum) is from station 346*a*, Long Point, Canada, August 18, 1899, and was taken with *P. parasitica* from a snapping turtle. The colors are lost in alcohol.

HERPOBDELLIDÆ.

Erpobdella punctata (Leidy).

Abundant throughout the lake region. (Pl. xxxii, fig. 1.)
(5*a*) South Bass Island, Ohio, pond near hatchery, July 6, 1899.
(7*a*, 8*a*, 9*a*) South Bass Island, Ohio, Lemna Pond, July 6, 1899.
(33*a*) South Bass Island, Ohio, East Swamp, July 10, 1899.
(43) South Bass Island, Ohio, August 17, 1898; shore.
(45) Put-in Bay Island, Ohio, Squaw Bay, August 15, 1898.
(67) Put-in Bay, Ohio, August 12, 1898; under rocks.
(89*a*, 90*a*) North Bass Island, Ohio, swamp, August 22, 1898.
(111*a*) Middle Bass Island, Ohio, North Swamp, July 24, 1899.
(115) South Bass Island, Ohio, swamp near East Point, August 24, 1899.
(118) South Bass Island, Ohio, August 22, 1898.
(127) South Bass Island, Ohio, September 10, 1898; shore.
(135) Put-in Bay, Ohio, September 13, 1898.
(136*a*) North Bass Island, Ohio, swamp, July 21, 1899.
(195*a*) North Bass Swamp, Ohio, July 21, 1899.
(266*a*) Erie, Pa., Graveyard Swamp, August 14, 1899; on stones and flags.
(365*a*) Long Point, Canada, August 21, 1899.
(403*a*) Long Point, Canada, August 24, 1899.
(438*a*) Rondeau Harbor, Ontario, East Swamp, August 28, 1899.

Dina fervida (Verrill).

Quite as plentiful as *E. punctata*, but apparently most abundant at the eastern end of the lake. (Pl. xxxii, fig. 6.)
(6*a*) South Bass Island, Ohio, Lemna Pond, July 6, 1899.
(44) South Bass Island, Ohio, pond near hatchery, August 16, 1898.
(124*a*) Sandusky, Ohio, East Harbor, July 28, 1899.
(191*a*) Sandusky, Ohio, East Harbor, August 7, 1899.
(219*a*, 220*a*) East Harbor, Ottawa County, Ohio, near Lakeside, August 4, 1899; on flags.
(266*a*) Erie, Pa., Graveyard Swamp, August 14, 1899; from stones and flags.
(271*a*) Erie, Pa., north shore, August 17, 1899.
(312*a*) Erie, Pa., Long Pond, August 15, 1899.
(317*a*) Erie, Pa., August 16, 1899.
(333*a*) Long Point, Canada, near boat landing, August 18, 1899.
(342*a*) Long Point, Canada, August 16, 1899.
(365*a*) Long Point, Canada, August 21, 1899.
(437*a*, 438*a*) Rondeau Harbor, Ontario, East Swamp, August 28, 1899.

Dina microstoma Moore.

In striking contrast to the abundant *Dina fervida* this species was found singly at but two stations.
East Harbor, Ottawa County, Ohio, August 5, 1898; on *Chara*.
(266*a*) Erie, Pa., Graveyard Swamp, August 14, 1899; on stones with *D. fervida*.

II. OLIGOCHÆTA.

This report is based upon collections made on Lake St. Clair in 1893, and on the upper end of Lake Michigan and the small lakes south of the Strait of Mackinaw in 1894 by a party sent out by the Michigan fish commission, and by the biological survey of Lake Erie under the auspices of the United States Fish Commission in 1899. Both parties were under the direction of Prof. Jacob Reighard, by whom the material was sent to me for determination. Most of the work in 1893 was done in the immediate vicinity of New Baltimore, at the northern extremity of Lake St. Clair, and so far as relates to the group of animals under consideration by Prof. H. B. Ward, who furnishes some careful notes and drawings of several species. A preliminary report on the field operations has been published as Bulletin No. 4 of the Michigan fish commission (Lansing, 1894), in which will be found some account of the physical and biological conditions of the region. The Oligochæta were originally sent to Dr. Eisen, who made a preliminary examination and brief report, but has been prevented from completing his studies. Dr. Eisen's list, published in the above-mentioned bulletin, is as follows, the name included in parenthesis following each of Eisen's determinations being, so far as can be determined, the corresponding name in the present report: Genus related to *Thamnodrilus* (*Sparganophilus eiseni*); new genus of Lumbriculidæ (*Thinodrilus inconstans*); two species of *Stylaria* (*S. lacustris* and *S. fossularis*); *Bohemilla* sp. (not found); *Pristina* (*P. leidyi*); *Naidium* (not found), and *Chætogaster* (*C. diaphanus* and *C. limæi*). The collections in Lake Erie were made chiefly in the vicinity of the Bass Islands, Sandusky, and other points at the western end of the lake, though a few Oligochæta were taken at Erie, Pa., and at points on the Canadian shore.

As most of the 15 species included in the two collections are well known either in this country or Europe, no descriptions of them are given in this paper, but after the name of each there is inserted a reference to one of the best easily accessible published descriptions, in nearly every case well illustrated. A key has been added, however, for the discrimination of the species, and the characters given are sufficient in most cases to separate them with considerable certainty from related species inhabiting the same waters. A full list of the localities at which each species was taken is given, the parenthesized number referring in each case to the station, and the data that follow being transcripts of the labels. Of the 15 species enumerated, 10 belong to the strictly aquatic family Naididæ and probably represent the majority of those likely to occur in this fauna. Several additional species of the Æolosomatidæ and Lumbriculidæ and many of the Tubificidæ are likely to be met with in the waters of the Great Lakes, while many Lumbricidæ and other earthworms have already been recorded from the bordering states.

Key to species of Oligochæta reported upon.

a. Size small; reproduction chiefly by means of serial asexual buds; sexually mature individuals rarely found; digestive tract simple; always strictly aquatic.

b. Central nervous system imperfectly developed, intimately connected with epidermis throughout; internal metamerism incomplete owing to the absence of some or all of the dissepiments. (Æolosomatidæ.)

c. In addition to capillary setæ the posterior bundles at least contain alternating shorter, straight, curved, or bifid setæ; prostomium broader than peristomium; integumental oil drops usually with a yellow or green tint.......................................*Æolosoma tenebrarum* (p. 166).

bb. Central nervous system complete, the brain, at least, quite distinct from the epidermis; dissepiments completely developed; forked setæ exclusively present in ventral bundles. (Naididæ.)

d. Prostomium distinct and more or less prominently developed; somite III not enlarged and the pharynx small and much shorter than the œsophagus; number of somites not greatly reduced; ventral setæ normally present on all somites behind the peristomium.

e. Prostomium produced into a papilliform or tentacular process.

f. Dorsal setæ beginning on somite III, partly capillary, partly acicular in each bundle; prostomial process a short papilla.................................*Naidium sp.* (p. 166).

ff. Dorsal setæ beginning on somite II, all capillary and those on III greatly elongated; except in the first two bundles the dorsal setæ are roughened with minute spines; prostomial process a long, slender tentacle....................*Pristina leidyi* (p. 166).

fff. Dorsal setæ beginning on VI, exclusively capillary and smooth, and those on III not materially longer than the others; prostomium without lateral lobes and tapering regularly into the slender elongated tentacle..............*Stylaria fossularis* (p. 167).

ffff. Like *S. fossularis*, except that the prostomium is provided with a pair of lobes, from the cleft between which the tentacular proboscis arises....*Stylaria lacustris* (p. 167).

ee. Prostomium rounded, without any produced process.

g. Dorsal setæ bundles present on all somites except the first five.

h. Dorsal setæ exclusively capillary, those on VI much longer than the others; integumental sense papillæ of large size and metameric; no expanded caudal plate..*Slavina gracilis* (p. 167).

hh. In addition to the capillary setæ dorsal bundles contain some that are curved and bifid or simply acicular, those on VI not longer than the others; no expanded caudal plate..*Nais elinguis* (p. 166).

hhh. Dorsal bundles composed of both acicular and capillary setæ not especially elongated on VI; the caudal somite broadly expanded into a plate bearing marginal ciliated branchial processes......................*Dero limosa* (p. 167).

gg. Dorsal setæ totally absent from all segments.

i. Form elongated as in *Nais*, the prostomium well developed; only 2 or 3 setæ in the ventral bundles.................................*Schmardaella filiformis* (p. 168).

dd. Prostomium rudimentary and not distinct from peristomium; somite III much enlarged for the accommodation of the large pharynx, which equals or exceeds the œsophagus in length; number of somites small, about 15 for the single zooid; ventral setæ totally wanting from somites III to V and dorsal setæ absent from all somites.

j. Length of living animal 10 to 15 mm.; the œsophagus short but distinct; habit free living....................................*Chætogaster diaphanus* (p. 168).

jj. Length of living animal 2 to 4 mm.; the œsophagus very short and indistinct; usually parasitic on water snails ....*Chætogaster limnæi* (p. 169).

aa. Size moderate or large; reproduction normally by the sexual method alone; alimentary canal often complicated by the development of a crop, gizzard or other organs; aquatic, semiaquatic or terrestrial. (Lumbriculidæ, Tubificidæ, Glossoscolecidæ, and Lumbricidæ.)

k. All setæ hooked and bifid distally, more than 2 per bundle in the preclitellar segments at least; a single pair of spermiducal funnels in X, 1 pair of spermathecæ in X; prostate glands elongated........*Limnodrilus gracilis* (p. 169).

kk. All setæ hooked and slightly bifid distally and arranged on all somites in 2 dorsal and 2 ventral pairs; 2 pairs of sperm funnels in somites IX and X; 5 pairs of spermathecæ in XI to XV or XII to XVI..*Thinodrilus inconstans* (p. 169).

kkk. Setæ simple-pointed but slightly ornamented, arranged in pairs as in *kk;* prostomium continuous with peristomium; clitellum extending from XIV to XXVI; male pores on XIX; 3 pairs of spermathecæ in VI, VII, and VIII; a pair of large glands in III; no muscular gizzard.
Sparganophilus eiseni (p. 170).

kkkk. Setæ as in *kkk*, but entirely without ornamentation; prostomium dovetailed into peristomium from which it is separated at the sides by grooves; clitellum beginning on XXV, XXVI, XXVII, or XXVIII, and ending on XXXIII, XXXIV, or XXXV; male pores on XV; 2 pairs spermathecæ in IX and X; gizzard well developed.....*Helodrilus caliginosus* (p. 171).

ÆOLOSOMATIDÆ.

Æolosoma tenebrarum Vejdovsky.

Æolosoma tenebrarum Vejdovsky, System u. Morphologie der Oligochaeten, p. 21. 1884.

Three specimens in the Lake St. Clair collection agree closely with this European species which has been recorded from Illinois by Professor Smith. They are, however, very small, varying from 1 to 3 mm. in length. According to a note furnished by Professor Ward they were, when alive, semitransparent grayish, with sparse greenish yellow oil drops. They were taken from the surface of a log at New Baltimore, Mich., on August 2, 1893.

NAIDIDÆ.

? **Naidium**, sp. Ward.

Professor Ward's notes mention a species of *Naidium* collected in the bottom tow at various times between August 8 and 25, 1893, at New Baltimore, Mich., but the specimens can not be found in the material furnished to me. The description is as follows:

"Length, 1.785 mm. to 2.95 mm.; diameter, 0.25 to 0.35 mm.; metameres, 14 to 26. Setae in 4 rows; the dorsal beginning on the third, the ventral on the second metamere; the dorsal hair like, 1 long, up to 0.546 mm., and 3 or 4 short, 1 or rarely 2 of which may equal half the length of the long one; ventral setæ, 5 to 7, hooked and very unequally bifid at the end and doubly bent internally. Head abruptly rounded in the smaller, furnished with a small papilliform proboscis in the larger examples, with numerous sensory hairs but no eyes. Œsophagus short; intestine beginning at second metamere, grayish on account of the presence of numerous light yellowish oil drops 2 μ in diameter, a dark band across the anterior end of each intestinal sacculation. No sexual organs nor traces of gemmation."

Sketches of 2 ventral setæ and of an entire worm with small proboscis accompany the note.

Pristina leidyi Smith.

Pristina leidyi Smith, Bulletin Illinois State Laboratory of Natural History, vol. IV, 1896, p. 397.

This species is represented in both collections by about 25 specimens which agree closely with Smith's description, though in all of them the setæ of the first 2 dorsal fascicles lack the spines present on all others, a distinction not mentioned in the original description. In the second bundle some of them often have a length of 5 or 6 times the diameter of the body. The budding zone occurs at XIII or XIV.

Besides those taken at New Baltimore, Mich., on several occasions during August, 1893, a few specimens occur with other naids in the material from each of the following Lake Erie stations: Lemna Pond, South Bass Island, Ohio (18*a*), July 7, 1899; swamp near East Point, South Bass Island, Ohio, August 2, 1899; Sandusky, Ohio, West Harbor (207*a*), August 8, 1899.

Nais elinguis Müller.

Nais elinguis, Vejdovsky, System u. Morphologie der Oligochaeten, p. 28, 1844.

All of the examples of *Nais* in the collection are tentatively and with much doubt referred to this species. Although taken at a number of stations, but 1 or 2 usually much broken and distorted examples occur in each lot, and these differ considerably in appearance. Some, for example, have conspicuously pigmented eyes and others possess little or no pigment. Ward has labeled some of the New Baltimore specimens *N. elinguis* and Smith has recorded this species as abundant in Illinois. Their identification has been permitted to outweigh my doubts. The dorsal setæ of every specimen examined carefully differ in form from those figured by Vejdovsky and others. The few budding specimens have the growth zone at XVII to XIX and the fully formed bud has about 21 segments. No sexual individuals were detected.

Specimens were taken among algæ in association with *Stylaria lacustris* at New Baltimore in July, 1893, at Round Lake July 16, 1894, and at the following stations in Lake Erie: East Harbor, August 5, 1898, in *Chara;* (36*a*) Squaw Bay, July 12, 1899, among bryozoans; (38*a*) Put-in Bay, Ohio, July 10, 1899, bottom tow; (207*a*) Sandusky, Ohio, West Harbor, August 8, 1899; (212*a*) Sandusky, Ohio, August 8, 1899, from *Utricularia* in East Harbor.

Slavina gracilis (Leidy) Vejdovsky.

Nais gracilis Leidy, Journal Academy of Natural Sciences of Phila., ser. 2, vol. II, 1850, p. 43.

The few examples by which this species is represented in the collection are in very poor condition and much distorted and obscured by the mucous tubes in which they are enveloped, and which have been hardened and much shrunken by the alcohol. There can be no doubt that they belong to Leidy's species, but the distinction of this from *S. appendiculata* (Udeken) Vejdovsky is not so clear. Sensory papillæ are well developed and on each somite are arranged in a circle of large ones in the setæ zone, and another of alternating smaller ones, both provided with sensory hairs; the anus is surrounded by 4 or 6 papillæ.

Birgeboro, August 19, 1893, 1 specimen; Lake St. Clair, unlabeled vial, 1 specimen; and Round Lake, July 16, 1894, 2 specimens, with *Nais*.

Dero limosa Leidy.

Dero limosa Leidy, American Naturalist, vol. XIV, 1880, p. 422.

This well-known naid appears to be abundant throughout the entire region covered by these collections. The position of the budding zone is very variable, being found as far forward as XX in small, and as far back as XXXVIII in large individuals, while the total number of segments varies from 36 to 76 in gemmating examples.

New Baltimore, Mich., August 19, 1893, abundant among algæ; Lake St. Clair, unlabeled bottle, numerous; Lemna Pond, South Bass Island, Ohio (18*a* and 78*a*), July 7–15, 1899, plentiful; swamp near East Point, Bass Island (117), August 27, 1898, numerous; Sandusky, Ohio, West Harbor (207*a*), 2 specimens; Squaw Bay, Put-in Bay Island, Ohio (36*a*), 1 specimen among bryozoans, July 12, 1899.

Stylaria lacustris (Linnæus) Lamarck.

Stylaria lacustris, Vejdovsky, System u. Morphologie der Oligochæten, p. 30, 1884.

This also is an abundant species, particularly in the Lake St. Clair region, but in Lake Erie appears to be less plentiful than the next. Among the material from station 17 in Carp Lake is one sexually mature example with well-marked clitellum and genital setæ. Most of the specimens, however, bear buds in various stages of development. Although the resemblance of our specimens to descriptions based on European examples is remarkably close, the ventral setæ are constantly more strongly hooked than Vejdovsky's figures indicate, and there are other slight differences.

Stylaria lacustris was taken at the following stations in and about Lake St. Clair. Birgeboro, August 19, 1893, about 15 specimens with *Chætogaster diaphanus;* New Baltimore, August 24, 1893, with other naids common among algæ in bottom tow (Professor Ward furnishes some excellent drawings of specimens from this lot); Fox Lake, a large number; also taken in the Birge bottom tow net at Crooked Lake (stations 3 and 5), Burt Lake (9), Mullet Lake (11 and 13), Carp Lake (17 and 18), and Bear Lake (20). Lake Erie localities are Put-in Bay (37*a* and 38*a*), July 10, 1899, bottom tow, plentiful; East Harbor, Sandusky (182*a*), August 4, 1899, several with *S. fossularis;* Sandusky, Ohio (212*a*), August 8, 1899, two specimens; Erie, Pa., boat landing, August 16, 1899, numerous; same date and locality (315*a* and 316*a*), several, with a large number of *S. fossularis*.

Stylaria fossularis Leidy.

Stylaria fossularis Leidy, Proceedings Academy of Natural Sciences of Philadelphia, vol. V, 1852, p. 287.

Although students of the Oligochæta have generally failed to discriminate between this species and *S. lacustris*, the two are in reality perfectly distinct and are easily separated, as was done by Leidy, by the form of the prostomium (fig. 3), which in this species is prolonged medially into the base of the proboscis and lacks altogether the lateral lobes which are so conspicuous in *S. lacustris*. The Lake Erie material is beautifully preserved and permits a detailed study of the specimens, which correspond exactly with those occurring in the neighborhood of Philadelphia. In the preserved state the brain is 2½ times as wide as long, with a nearly straight anterior margin and a pair of prominent posterior lobes separated by a deep median emargination. Almost all of the specimens are in process of stolonization, and the budding zone is situated with remarkable constancy at XXXIV. No sexually mature examples were found, but the large buds of some from Lake St. Clair appear to be nearing that condition, and at least one has genital setæ distinctly developed on V.

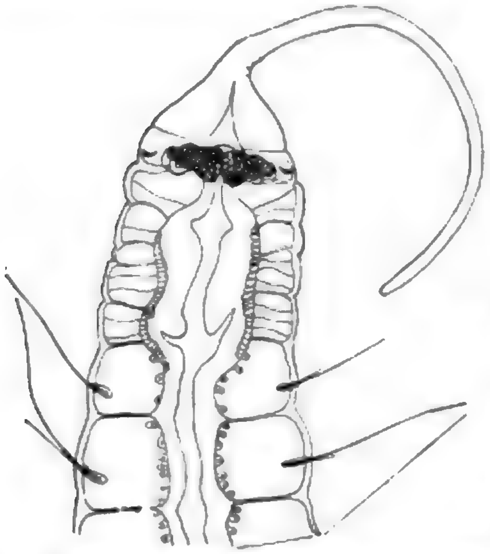


FIG. 3.—*Stylaria fossularis*, dorsal view of anterior seven somites, showing form of prostomium, brain, etc. × 60.

This species was taken at New Baltimore on August 8, 1893, among weeds, at Round Lake July 16, 1894, on the bottom, Burt Lake (9), Mullet Lake (13), and at an unknown station in Lake St. Clair. It occurred at Sandusky on August 4, 1899, and very abundantly at the boat landing at Erie, Pa., with *S. lacustris* on August 16, 1899.

Schmardaella filiformis (Schmarda) Michaelsen ?.

Schmardaella filiformis, Beddard, Ergebnisse der Hamburger Magelhaensischen Sammelreise, Naididæ, p. 5, 1896.

The most important result yielded by this collection of Oligochæta is the addition of *Schmardaella* to the North American fauna. Whether or not the few imperfect specimens represent a new species is uncertain, and though it seems probable that this will eventually prove to be the case our knowledge of both the type and this species is so very incomplete that a definite opinion can not be ventured, and it seems best for the present to record the specimens with this explanation under the above name. *S. filiformis*, the type and only known species, has been found only in Ecuador and Chile, and was described by Schmarda and later by Beddard.

The 3 specimens in this collection, which have neither buds nor sexual organs, were all taken among Chara stems dredged at New Baltimore on August 20, 1893. They vary from 5.3 mm. to 6.5 mm. in length and have from 46 to 52 segments. The prostomium is prominent and rounded; the anterior 2 or 3 somites somewhat enlarged. Dorsal setæ are totally absent, the ventral on all somites considerably enlarged, their length equaling two-thirds or more of the body diameter (fig. 4). In the largest specimen many of the fascicles of the middle region contain 3 setæ, the majority having but 2, while in the smaller ones very few have 3. All are strongly *f*-shaped, with a small but distinct nodulus a little beyond the middle, the tip strongly hooked and bifid, with the 2 prongs strongly divergent, of equal length, and the terminal one half as thick as the accessory. On the first 3 or 4 somites the setæ are more slender, though, owing to the variability of the latter, this may have little significance. The ventral lip of the anus is slightly longer than the dorsal, and bears a pair of small papillæ. Notwithstanding the absence of the dorsal setæ *Schmardaella* is clearly not closely related to *Chætogaster*. So far as it can be made out the alimentary canal is much like that of *Nais*. The brain seems to approach the form of *Dero limosa*, but is narrower. Schmarda figures a worm of 15 segments, and shows 3 setæ per fascicle, while Beddard states that there are but 2. Nothing whatever is known of the genital organs.

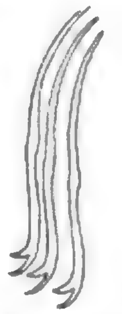


FIG. 4.—*Schmardaella filiformis*, a fascicle of three setæ from middle of body. × 270.

Chætogaster diaphanus (Gruithuisen) Oersted.

Chætogaster diaphanus, Vejdovsky, System u. Morphologie der Oligochaeten, p. 37, 1884.

Many specimens of this beautiful annelid in a state of active bud formation are found in both the Lake St. Clair and Lake Erie collections. Lake St. Clair, August 19 and 22, 1893, bottom, among algæ, several; Round Lake, July 16, 1894, several; Lake Erie (38*a*) July 7, 1899, many; East Harbor, Sandusky, Ohio (182*a*), August 4, 1899, 2 specimens; Sandusky, Ohio, August 4, 1899 (212*a*), 1 specimen.

Chætogaster limnæi v. Bær.

Chætogaster limnæi, Wilcox, American Naturalist, vol. xxxv, 1901, p. 906.

The American examples of this species differ from the European in a number of minor points which will probably require their eventual separation. Some of these differences have been alluded to in Miss Wilcox's excellent description of the species. It is common about Philadelphia and was well known to Dr. Leidy, by whom some excellent manuscript drawings were left, and has been recorded by Professor Smith from Illinois.

Many, both of parasitic and free-living individuals, are included in this collection from the following stations: New Baltimore, Mich., August 14, 1893, several from *Amnicola limosa;* Charlevoix, Mich., August 6, 1894, from *Limnæa stagnalis*, many; Middle Bass Island, Ohio, North Swamp, July 21, 1899, (105*a*), a large number.

LUMBRICULIDÆ.

Thinodrilus inconstans Smith.

Thinodrilus inconstans Smith, Bulletin Illinois State Laboratory of Natural History, vol. iv, 1895, p. 292.

In most respects these specimens agree exactly with Smith's description, but one example sectioned has both anterior and posterior sperm sacs, the former beginning at the septum VIII/IX and reaching to VII, the latter beginning at X/XI and extending to XIV. The paired male orifices are in X and there appears to be a small eversible penis, though it is retracted in all specimens. Five pairs of very small spermathecæ occur in XII to XVI. None of the examples is mature.

About a dozen of the largest examples are contained in an unlabeled vial belonging to the Lake St. Clair collection, and a few fragments each occur in vials labeled (126) South Bass Island, Ohio, near East Point, September 10, 1898, and (32*a*) East Swamp, South Bass Island, Ohio, July 10, 1899.

TUBIFICIDÆ.

Limnodrilus gracilis sp. nov.

Form very slender and elongated, the length reaching 75 mm.; clitellum on XI and XII, but only very slightly developed and none of the examples with enlarged genital region; number of somites, 140 to 175; prostomium flattened, moderately long.

Setæ anterior to X, 4 or 5, sometimes 3 or 6 per bundle; posterior to clitellum usually 2, occasionally 3, and in the posterior fourth of the body only 1, in each bundle. On X the dorsal bundle usually contains 3, the ventral 2 setæ, and the glands which are associated with the setæ bundles of all anterior somites are on this one better developed than elsewhere. On XI ventral setæ are usually absent altogether, their place being occupied by the male genital orifices, while the dorsal bundle is composed of 2 or 3 setæ. All setæ are hooked and bifid and have the form shown in figure 5. Those on the genital and posterior somites have the same shape as the others, but the latter are somewhat smaller.

None of the specimens is nearly mature, but the reproductive organs are sufficiently well developed to indicate their characteristic features (fig. 6). Spermathecæ, 1 pair in X, of fairly large size, reaching vertically nearly to the dorsal wall of the body. They are of simple clavate form and, although the upper end is considerably inflated and has much thinner walls than the lower half, there is no clear distinction between duct and pouch. The external opening is in line with the ventral setæ, is simple and without glands or other special features. The spermathecæ are filled with elongated spermatophores having clear centers. Testes, 1 pair, attached on each side near the posterior base of the septum IX/X, long, slender, rising freely into the dorsal part of the body cavity and reaching backward to the spermathecæ. Male efferent organs are not fully developed. Their deeply funnel-form cœlomic ends are in X, with the mouth opening directly dorsad. The vas deferens perforates the septum X/XI in line with the ventral setæ

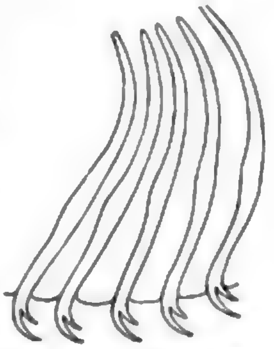


FIG. 5.—*Limnodrilus gracilis*, a ventral seta bundle from V. × 270.

close to the body floor, forms in XI a sinuous loop or two leading dorsad by the side of the intestine and expands into a fusiform receptaculum, the anterior end of which bears a prominent prostate gland usually drawn out into two slender lobes. A short ductus leads to the atrium which is cylindrical and about three times as long as thick. From the ventral body wall the atrium rises to the side of the intestine. Penis sheath simple, smooth, and chitinous; the penis in retracted condition apparently about 5 or 6 times its diameter and of uniform thickness. Paired external pores in line with spermathecal pores and smaller than they.

The septum X/XI is produced caudal through XI as a single median (or perhaps a pair of closely approximated), sperm sac having the form of a narrow tube, into which the lateral vascular arches of X enter. The septum XI/XII is similarly pushed back into a certainly unpaired tubular ovisac, into which both the sperm sac and the vascular arches enter, the latter much looped and folded. In the specimens sectioned the combined sperm and ova sacs reach only to the posterior end of XII, and while the former is crowded with spermatozoa the latter contains no ova. Similarly to the testes, the ovaries are attached to the posterior face of septum X/XI just laterad of the point of passage of the vas deferens. They are much longer than the testes and loop across the upper part of the body cavity several times. The interior of the egg strings is a granular mass with little or no trace of cell boundaries or nuclei and appears to be formed of disintegrated ova. Whether or not these egg strings are entirely free from the ovaries is uncertain.

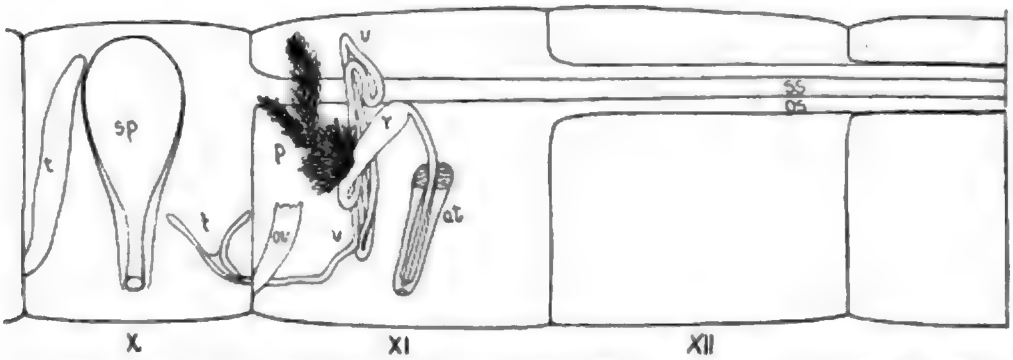


FIG. 6.—Diagram of the principal reproductive organs contained in the tenth, eleventh, and twelfth somites of *Limnodrilus gracilis*, as seen from the side; *t*, testes; *sp*, spermatheca; *f*, sperm funnel; *v*, *v*, vas deferens; *p*, prostate gland; *r*, receptaculum seminies; *at*, atrium containing penis and penis sheath and opening externally at ♂; *ov*, ovary, largely cut away, only the base remaining; *ss*, sperm sac; and *os*, ovisac, both represented as continued beyond somite XII.

Brain about as broad as long, with thick masses of ganglion cells and very shallow anterior and posterior emarginations. Vascular arches of the first seven somites very long, branched, and complexly folded, forming a conspicuous system of integumental vessels. Large hearts in VIII and IX. Chlarogogue cells begin in VIII.

This species was found at several stations (431*a*, 432*a*, 477*a*) among reeds about the shore of Rondeau Harbor, Ontario, during the latter part of August, 1899, and at Norwood, Mich., was dredged in 13 fathoms on August 8, 1894. The former is the type locality, and the type specimen is no. 5227, U. S. National Museum.

GLOSSOSCOLECIDÆ.

Sparganophilus eiseni Smith.

Sparganophilus eiseni Smith, Bulletin Illinois State Laboratory of Natural History, vol. IV, 1895, p. 142.

This species was found at Lake St. Clair August, 1894, 2 small specimens taken on the bottom with the Birge net; bank of Round Lake, Charlevoix, Mich., July 20, 1894, two immature specimens; High Island Harbor, Beaver Islands, Michigan, trawled in Chara, 1 large example; Squaw Bay, Put in

Bay, Ohio, August 12, 1898 (67), under a rock, 1 small specimen; Long Point, Lake Erie, Canada, August 23, 1899 (382), two very small specimens referred doubtfully to this species upon the basis of setæ characters; Rondeau Harbor, Ontario (418*a*), August 30, 1899, 1 specimen.

LUMBRICIDÆ.

Helodrilus caliginosus (Savigny) Michaelsen.

Helodrilus caliginosus, Michaelsen, Das Tierreich, Oligochaeta, p. 482, 1900.

Nine specimens of this species were taken near Port Clinton, Ohio, on the bank of the Portage River on August 12, 1895. The clitellum begins on XXVI; on one specimen on XXV. In all other respects they are normal.

EXPLANATION OF PLATE.

The figures on this plate were drawn and colored from living examples taken at Put-in Bay during the survey of Lake Erie. The figures are numbered from left to right: 1 to 3 above, 4 to 6 below.

Fig. 1. *Erpobdella punctata* (Leidy) Moore. A young example. The pink color on the margin is due to a wave of blood passing through the lateral vessel. × 4.

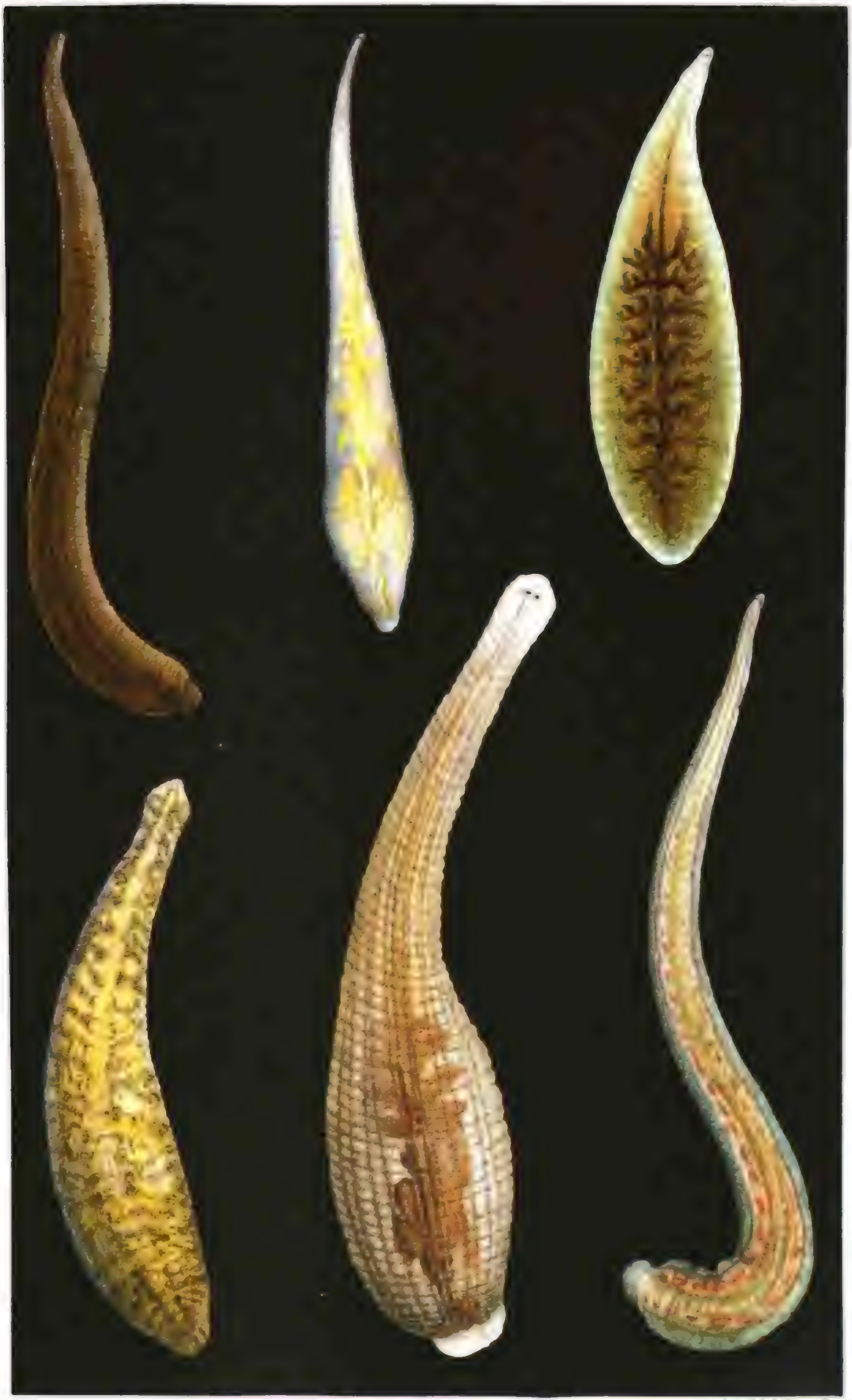
Fig. 2. *Glossiphonia stagnalis* (Linnæus) Blanchard. A nearly full-grown example. The nuchal gland is scarcely evident in the figure, and the stomach and intestine (containing little or no blood) are pale yellow. × 8.

Fig. 3. *Placobdella picta* (Verrill) Moore. A small and pale specimen, with the branched gastric cæca very distinct. × 4.

Fig. 4. *Glossiphonia complanata* (Linnæus) Johnston. A small and lightly pigmented example, with the dark paramedian lines very little developed. × 10.

Fig. 5. *Glossiphonia fusca* Castle. A full-grown example of the lined variety, with the stomach and intestine partially filled with blood. × 15.

Fig. 6 *Dina fervida* (Verrill) Moore. A nearly full-grown pale specimen, with three pairs of eyes and an additional one on the right side. The red color is due to the blood, seen through the transparent tissues. Fully extended. × 3.



LAKE ERIE LEECHES

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THE FISHES OF SAMOA

DESCRIPTION OF THE SPECIES FOUND IN THE ARCHIPELAGO, WITH A PROVISIONAL CHECK-LIST OF THE FISHES OF OCEANIA

By DAVID STARR JORDAN AND ALVIN SEALE

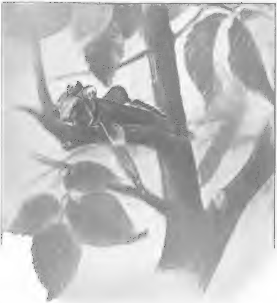

Fig. 1.—*Pterapoditamus serratus* Linnæus.

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INTRODUCTION.

The islands of Samoa, known also as the Navigator Islands, or Schiffer Insel, lie in the South Pacific Ocean in latitude 14° south and longitude 172° west. They are volcanic in character, each of the larger ones rising in a high ridge, with extinct craters, now very heavily wooded. The almost constant rains tend to make these forests very dense, feeding swift, clear streams, which carry a large volume of water considering the slight length of their courses. Each island is surrounded by a broad coral reef, the outer parts bare at low tide, with a narrow, shallow channel between the inner part and the shore. This reef is interrupted in certain regions, known as the "iron-bound" coast, where the lava rocks cease abruptly beside deep water. It is also interrupted at the mouths of certain streams, which by their fresh waters kill the coral and make a channel through the reef.

Of these islands the westernmost, Savaii, about 45 miles long by 30 miles broad, is the largest and the most recent geologically. Upolu, 40 miles by 15 miles, is near it in size and position. On the north side of the latter island is the broad V-shaped Bay of Apia, which can scarcely be called a harbor, as it is filled up by the reef with the exception of a deep and tortuous channel opposite the mouth of the river Vaisigano, a considerable stream, perhaps the largest on the islands. Upolu and Savaii are now under the German flag, with the capital at Apia. On the west side of the Bay of Apia is the long, narrow peninsula of coral sand, known as Mulinu'u, the residence of Mataafa, chief of Samoa, and the former residence of the kings of the islands. To the west of Mulinu'u is the shallow Bay of Vaitele, and to the eastward of Apia is the larger Bay of Vailele. Into Vaitele Bay flows Gasegase River. Into the Bay of Apia flows the Vailema stream and the Vaisigano River, while to the eastward Vaivasi River runs into the Bay of Vailele.

The next island in size and importance is Tutuila, 20 miles long by about 4 miles broad, which lies about a deep crater, with the two high peaks of Matabas and Peoa adjoining it. The crater has a narrow opening at one side and forms the landlocked harbor of Pago Pago, the best in Polynesia, about 2.5 miles long and 1 mile wide, with everywhere a broad rim of coral reef. There is a small stream near the head of the harbor, and there are springs along the side.

The oldest island is Manua, still farther to the eastward, nearly circular, and about 10 miles across, and there are also about six smaller islets, none of which was examined by us. The islands of Tutuila and Manua are now under the flag of the United States.

In the summer of 1902 investigation of the fish and fisheries of this archipelago was made under the auspices of the U. S. Bureau of Fisheries.[a] The work was conducted chiefly from Apia and Pago Pago; and during the comparatively short time devoted to it, rich collections, numerous as to species and individuals, were obtained, and many species new to science were discovered.

The coral reefs of the South Seas literally swarm with fishes. The larger species live in the deeper channels, passing in and out with a display of brilliant colors. The smaller species, as Pomacentridæ, Blenniidæ, Chætodontidæ, live on the surface of the reefs and are segregated in pools as the tides recede. Many of these reef fishes show marked protective coloring, having the hues and markings of the reef itself. Still others show what may be termed defiant coloring, their hues of blue, scarlet, yellow, and green being in vivid contrast to the rocks about them. Nowhere are these reef fishes more brilliant than in Polynesia. It is not easy to explain the reason for these vivid hues, nor for the elaborate and striking markings which accompany them. It is clear that protective coloration is needless, for these species are exceedingly active and when disturbed move through the water like animated lightning; but why such a riot of color should exist is not evident. There is apparently no advertising end to be served, and the idea that recognition has a high value to the species has never been received with favor by naturalists. In the record of the voyage of Captain Cook is the following account of the fishes of the atoll called Palmerston Island:

> At one part of the reef which bounds the lake within, almost even with the surface, there was a large bed of coral, which afforded a most enchanting prospect. Its base, which was fixed to the shore, extended so far that it could not be seen, so that it appeared to be suspended in the water. The sea was then unruffled, and the refulgence of the sun exposed the various sorts of coral in the most beautiful order; some parts luxuriantly branching in the water, others appearing in vast variety of figures, and the whole greatly heightened by spangles of the richest colors, glowing from a number of large clams, interspersed in every part. Even this delightful scene was greatly improved by the multitude of fishes that gently glided along, seemingly with the most perfect security. Their colors were the most beautiful that can be imagined: blue, yellow, black, red, &c., far excelling anything that can be produced by art. The richness of this submarine grotto was greatly increased by their various forms, and the whole could not possibly be surveyed without a pleasing transport, accompanied, at the same time, with regret that a work so astonishingly elegant should be concealed in a place so seldom explored by the human eye.

The fish fauna of Upolu and Tutuila is entirely the same, nor is there evidence of any divergence from the fauna of Tahiti, Tonga, and other islands of similar character. It is largely identical with that of the East Indies, from which nearly all of its elements are clearly derived. But a number of East Indian species fail to extend their range thus far to the east, very many of them not ranging beyond the island of Papua or New Guinea. A few large species are confined to the islands of Polynesia, and many of the small ones, especially those living in crevices in the coral, seem to have originated in Polynesia. It is a general rule of distribution that with any given species the one nearest related will be found in neighboring waters, but not in the same waters. This indicates that in general species have a basis in geographical separation. But the Samoan species of *Eviota*, *Enneapterygius*, *Salarias*, and the like seem to form exceptions to this rule. Here closely related species live in the same region. Perhaps these forms originate in saltations or "mutations". More likely the isolation of different coral masses is sufficient to prevent the migration of individuals, and hence to favor the selection of fluctuations under varying conditions, thus producing distinct species in regions not far separated. As most of these little fishes are less than an inch long and local in their habit, this is possible. The conditions illustrate the remark of Dr. Elliott Coues that "migration holds species true; localization lets them slip." In other words, a species splits up into minor groups if its range is divided by barriers preventing free movement of individuals.

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[a] This expedition was under the direction of Dr. David Starr Jordan, who was assisted in the work by Prof. Vernon Lyman Kellogg and Mr. Michitaro Sindo, of Stanford University for the Bureau, and the volunteer service of Prof. Robert Edgar Allardice, of Stanford University, and Knight Starr Jordan.

Acknowledgments for assistance of various kinds are due to the governor of Samoa, Dr. Schnee, and to Mr. H. J. Moors, of Apia; to Capt. Uriel Sebree, U. S. Navy, commandant at the station, and his officers and assistants, through whom the U. S. gunboat *Wheeling* and its equipment were placed at the disposal of the investigating party; to Mauga, chief of Tutuila, and to Tuatagaloa in Apia, through whose interest many small reef fishes were obtained; and to various Samoan assistants, chief among whom were Taua, Vaiula, Musila, and Salewale, of Apia, and Afele, of Pago Pago, whose services contributed much to the success of the work.

The previous collections of fishes from Samoa have been relatively few. The earliest recorded species, from Apia, was named *Diagramma gibbosum* by Hombron & Jacquinot in their ichthyology of the "Voyage au Pole Sud" by Dumont D'Urville, published in 1841.

Later, 1868 to 1870, the gigantic trading house of "Cæsar Godeffroy und Sohn" of Hamburg made Apia the center of its operations. Among other workings of this firm was the establishment at Hamburg of the Godeffroy Museum and the publication for a time of a "Journal des Museum Godeffroy," in which the natural history of the South Seas was elaborately treated. Among other papers on this subject, the "Fische der Südsee" of Dr. Albert Günther (1873) is especially noteworthy. This is based primarily on a series of colored life sketches of the fishes of Hawaii, Tahiti, Samoa, and other islands, made by Mr. Andrew Garrett in the several years of his residence in Polynesia. In this paper descriptions are given of most of the fishes then known from the South Seas, with excellent colored plates of a large proportion of these. Unfortunately, the Godeffroy firm fell into financial embarrassment, the publication of its journal was suspended, and the "Fische der Südsee" was never completed, ceasing abruptly in the family of *Labridæ*.

From the Godeffroys a considerable number of fishes had been earlier sent to the Museum of Vienna, where, about 1868, they had been described by Dr. Rudolph Kner and Dr. Franz Steindachner. Still later, Rev. S. J. Whitmee, a missionary resident on the island of Savaii, sent to the British Museum a large and well chosen collection from Savaii and Upolu. A part of this collection has been used by Dr. George Albert Boulenger in the preparation of the first volume of his Catalogue of Fishes of the British Museum. Outside the percoid group, however, this collection remains unstudied. A small collection also was made about 1876 by Dr. Streets, of the United States Navy. It was described in the Bulletin of the U. S. National Museum, volume VII, in 1877. A few species in the Academy of Natural Sciences at Philadelphia, collected by Mr. Caldwell, have been recorded by Mr. Henry W. Fowler.

At the time of our visit at Samoa the following species, 164 in number, were known from the Samoan Islands; about six were not taken by us; and in regard to a few there is some question of correctness of identification. The nomenclature in this list is that adopted in the present paper.

LIST OF SPECIES KNOWN FROM SAMOA PRIOR TO 1902.

Fistularia petimba.
Macrorhamphosus brevispinis.
Liza cæruleomaculata.
Liza troscheli.
Polydactylus plebeius.
Holotrachys lima.
Holocentrus ruber.
Holocentrus punctatissimus.
Holocentrus diadema.
Holocentrus microstomus.
Holocentrus opercularis.
Holocentrus lævis.
Megalaspis cordyla.
Caranx forsteri.
Scomberoides sanctipetri.
Trachinotus ovatus.
Trachinotus bailloni.
Pempheris oualensis.
Epinephelus merra.
Epinephelus fuscoguttatus.
Epinephelus socialis.
Epinephelus sonnerati.
Cephalopholis argus.
Cephalopholis miniatus.
Variola louti.
Paracanthistius maculatus.
Kuhlia marginata.
Amia novemfasciata.
Amia savayensis.
Mionorus graeffei.
Apogonichthys variegatus.
Euelatichthys crassispinus.
Plectorhynchus diagramma.
Plectorhynchus orientalis.
Priacanthus cruentatus.
Scolopsis trilineata.
Scolopsis lineata.
Xystæma gigas.
Gnathodentex aurolineatus.
Terapon jarbua.
Monotaxis grandoculis.
Kyphosus waigiensis.
Læthrinella miniata.
Læthrinus mensi.
Lethrinus ramak.
Pharopteryx melas.
Pharopteryx nigricans.
Upeneus vittatus.
Mulloides samoensis.
Pseudupeneus barberinus.
Pseudupeneus indicus.
Pseudupeneus moana.
Pomacentrus nigricans.
Pomacentrus lividus.
Chromis cæruleus.
Dascyllus aruanus.
Abudefduf sordidus.
Abudefduf dicki.
Abudefduf unioccllatus.
Abudefduf amabilis.
Abudefduf leucopomus.
Abudefduf zonatus.
Abudefduf bonang.
Labrichthys cyanotænia.
Labroides dimidiatus.
Cheilinus digrammus.
Cheilinus trilobatus.
Pseudocheilinus hexatænia.
Hemigymnus melapterus.
Anampses melanurus.
Anampses diadematus.
Stethojulis casturi.
Stethojulis renardi.
Stethojulis strigiventer.
Thalassoma schwanefeldi.
Monodactylus argenteus.
Platax orbicularis.
Chætodon ulietensis.
Chætodon lineolatus.
Chætodon citrinellus.
Chætodon semeion.
Chætodon unimaculatus.
Chætodon quadrimaculatus.
Heniochus monoceros.
Holocanthus diacanthus.
Holocanthus bicolor.
Holocanthus nicobariensis.
Siganus marmoratus.
Hepatus matoides.
Hepatus aterrimus.
Hepatus lineatus.
Hepatus nigricans.
Hepatus achilles.
Hepatus guttatus.
Zebrasoma veliferum.
Ostracion punctatum.
Balistapus aculeatus.
Platycephalus variolosus.
Sebastopsis guamensis.
Scorpænopsis gibbosa.
Pterois radiata.
Dendrochirus brachypterus.
Mapo fuscus.
Rhinogobius neophytus.
Awaous genivittatus.
Awaous ocellaris.
Zonogobius semidoliatus.
Paragobiodon echinocephalus.
Amblygobius phalæna.
Valenciennea violifera.
Asterropterix semipunctatus.
Eleotris fusca.
Hypseleotris guntheri.
Pseudogobiodon citrinus.
Gobiodon ceramensis.
Periophthalmus barbarus.
Soleichthys heterorhinos.
Parapercis tetracanthus.
Enneapterygius minutus.
Enneapterygius hemimelas.
Petroscirtes tapeinosomus.
Petroscirtes atrodorsalis.
Petroscirtes longifilis.
Alticus evermanni.
Alticus sebæ.
Alticus variolosus.
Alticus alboguttatus.
Alticus periophthalmus.
Salarias edentulus.
Salarias fasciatus.
Exallias brevis.
Antennarius drombus.

The fish fauna of the Samoan Islands is one of the richest on the globe. In our short stay we obtained 475 species, of which 92 seem to be new to science. The following is a list of these new forms.

LIST OF 92 SAMOAN SPECIES BELIEVED TO BE NEW.

Himantura fai.
Gymnothorax talofa.
Echidna trossula.
Anarchias allardicei.
Anarchias knighti.
Rhinamuræna eritima.
Zenarchopterus vaisiganis.
Anchovia evermanni.
Anchovia apiensis.
Myripristis sanguineus.
Corythroichthys sealei.
Corythroichthys waitei.
Corythroichthys mataafæ.
Microphis torrentius.
Atherina uisila.
Decapterus lundini.
Caranx gilberti.
Amia exostigma.
Amia doryssa.
Foa vaiulæ.
Foa fo.
Apogonichthys isostigma.
Ambassis vaivasensis.
Ambassis lafa.
Pseudupeneus moana.
Chorististium susumi.
Pomacentrus eclipticus.
Pomacentrus vainli.
Abudefduf taupou.
Abudefduf metallicus.
Chromis iomelas.
Halichœres dædalma.
Platyglossus flos-corallis.
Callyodon fumifrons.
Callyodon kelloggi.
Callyodon maoricus.
Callyodon pyrrhurus.
Callyodon ruberrimus.
Callyodon erythacus.
Callyodon upolensis.
Callyodon zonularis.
Callyodon abacurus.
Callyodon latax.
Callyodon cyanogrammus.
Callyodon ultramarinus.
Callyodon lazulinus.
Hepatus aquilinus.
Dendrochirus sausaulele.
Sebastapistes laotale.
Synchiropus lili.
Eviota afelei.
Eviota smaragdus.
Eviota sebreei.
Eviota pruinosa.
Eviota zonura.
Eviota distigma.
Eviota prasites.
Eviota herrei.
Drombus tutuilæ.
Valenciennea violifera.
Trimma cæsiura.
Glossogobius vaisiganis.
Vailima stevensoni.
Vaimosa fontinalis.
Mapo crassiceps.
Mars strigilliceps.
Rhinogobius corallinus.
Rhinogobius muscarum.
Chænogobius erythrops.
Vitreola sagitta.
Kelloggella cardinalis.
Hetereleotris phaenna.
Hetereleotris clara.
Sicyopterus tauæ.
Hypleurochilus vaillanti.
Alticus evermanni.
Alticus musilæ.
Alticus thalassinus.
Salarias atkinsoni.
Salarias garmani.
Salarias sindonis.
Salarias bryani.
Blennius tonganus.
Petroscirtes azureus.
Petroscirtes xestus.
Enneapterygius hudsoni.
Enneapterygius pardochir.
Enneapterygius tusitalæ.
Enneapterygius tutuilæ.
Enneapterygius cerasinum.

All of the specimens are from the reefs; we had no means of fishing in the open sea. In general, we had four methods of collecting: First, the use of dynamite, by which nearly all our large fish were taken. Second, the use of poison in the pools on the reef at low tide; the poisons used were commercial chloride of lime and sulphate of copper, the first much to be preferred, and thus were obtained hundreds of small fishes, notably Pomacentridæ, Gobiidæ, Blenniidæ, and eels. Third, the use of the seine along the shores, whereby the herring and other shore fishes were taken. Fourth, the employment of divers to bring up coral heads, which when broken yield many specimens of *Eviota*, *Enneapterygius*, and the smaller eels. The larger fishes, *Callyodon* excepted, have been described long since, but most of the little fishes taken from the corals are new. This method of collecting has never been practiced by other naturalists in this region.

In the present paper are given the field notes of Professors Jordan and Kellogg, the descriptions of new species, with other notes, and enough of synonymy to complete the references given by Dr. Günther in his "Catalogue of Fishes of the British Museum" and his "Fische der Südsee", and those given by Dr. Boulenger in volume I of his edition of the British Museum Catalogue; and of those given by Jordan and Evermann and by Dr. Gilbert in their recent reviews of the fishes of Hawaii. Synonymy is given in general only when our studies have added something to the record given by these authorities. Type localities are shown in the synonymy in heavy-face type.

The colored plates are in some cases a revision of field sketches by Dr. Jordan; the others were made from specimens that had not faded. Some of the sketches are not quite accurate in certain details of scales and fin rays, but the shades of coloration are very well shown.[a]

The area represented in this list comprises Hawaii, Polynesia, Melanesia, and Micronesia. It excludes New Zealand, Torres Straits, the Arafura Sea, and the islands to the westward of Waigiu and to the southward of the Louisiades; but the eastern coast of New Guinea is included. All the species we find recorded from these regions are embraced in the list. There are doubtless numerous omissions, and there are many nominal species which will be eliminated when the region is fully explored.

Of these regions, the fauna of Hawaii is much the most distinct from that of Samoa. With most of the same genera, the species of shore fishes in Hawaii are very largely distinct from those of Polynesia. This is due to the long separation of Hawaii, and perhaps to the westward direction of her ocean currents, while those of Samoa and Tahiti trend eastward. The very extensive fauna of Melanesia is essentially that of the East Indies, with the loss of some species, and the incursion of very many others from Australia. The fauna of Micronesia differs little from that of Polynesia.

The islands whose fish fauna is considered may be classified as follows:

HAWAII.

Hawaii.
Oahu.
Molokai.
Maui.
Lanai.
Kauai.
Niihau.
Bird.
Necker.
French Frigate Shoal.
Laysan.
Midway.
Johnston.

POLYNESIA.

- Fanning Islands:
    - Palmyra.
    - Christmas.
    - Thornton.
- Marquesas Islands:
    - Nukahiva.
- Paumotu Islands:
    - Gambier Islands (Mangareva).
    - Makatea.
    - Pitcairn.
- Tahiti, or Society Islands:
    - Tahiti (Otaheite).
    - Raiatea (Ulietea).
    - Huahine.
    - Billingshausen.
- Cook Islands:
    - Rarotonga.
- Austral Islands:
    - Tubuai.
- Samoa, or Navigator Islands:
    - Savaii.
    - Upolu.
    - Tutuila.
    - Manua.
    - Rose.
- Tonga, or Friendly Islands:
    - Tongatabu.
    - Vavau.
- Kermadec Islands:
    - Raoul, or Sunday.
- Fiji Islands:
    - Viti Levu.
    - Vanua Levu.
    - Ovalau.
    - Levuka.
    - Kandavu.
    - Kanathia.

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[a] The colored drawings for the most part were made by Kako Morita; the uncolored sketches are the work of Chloe Leslie Starks, W. S. Atkinson, R. L. Hudson, and Sekko Shimada.

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MELANESIA.

- New Hebrides:
    - Banks Group.
    - Espiritu Santo.
    - Faté (Vate).
    - Aneiteum.
    - Tanna.
    - Erromango.
- Loyalty Islands:
    - New Caledonia.
- Santa Cruz Islands:
    - Vanicolo (Vanikoro).
    - Ticopia.
- Solomon Islands:
    - Guadalcanar.
    - Shortland.
    - Alu.
    - Bougainville.
    - New Georgia.
    - San Cristobal.
- Bismarck Archipelago:
    - Admiralty Islands.
    - New Hanover.
    - New Ireland (New Mecklenberg).
    - Duke of York Group.
    - New Britain (New Pomerania).
    - L'Echiquier Islands.
- Papua, or New Guinea:
    - Waigiu.
    - Misol.
    - Rawak.
    - New Guinea.
    - D'Entrecasteaux Islands.
    - D'Urville Islands.
    - Percy.
    - Normanby.
    - Moresby.
    - Louisiades.

MICRONESIA.

- Phœnix Islands:
    - Howland.
    - Sydney.
- Ellice Islands:
    - Rotumah.
    - Nurakita.
    - Funafuti.
- Gilbert Islands:
    - Makin.
    - Apamana.
- Marshall Islands:
    - Jaluit.
        - Bonham.
    - Radack Islands.
- Caroline Islands:
    - Kusaie (Strong or Oualan).
    - Yap.
    - Rug.
    - Royalist.
    - Pingelap.
    - Ulea (Wolea).
- Ladrone Islands (Mariana):
    - Guam.
- Bonin Islands:
    - Marcus.
- Palau Islands (Pelew).

SYSTEMATIC LIST OF SPECIES.

Family BRANCHIOSTOMIDÆ.

AMPHIOXIDES Gill.

1. **Amphioxides pelagicus** (Günther). Deep waters of Hawaii.

EPIGONICHTHYS Peters. (*Asymmetron* Andrews.)

2. **Epigonichthys caudatus** (Willey). Louisiades.

Asymmetron caudatum Willey, Quart. Jour. Mic. Soc. 1896, 219, **Louisiades.**

Family SCYLLIORHINIDÆ.

CATULUS Smith.

3. **Catulus spongiceps** Gilbert. Deep seas of Hawaii.

Family HEMISCYLLIDÆ.

HEMISCYLLIUM Müller & Henle.

4. **Hemiscyllium ocellatum** (Gmelin). New Guinea (Macleay); Australia.

5. **Hemiscyllium freycineti** (Quoy & Gaimard). Waigiu.

Scyllium freycineti Quoy & Gaimard, Voy. Uranie, 192, 1824, **Waigiu.**
Scyllium malaisianum Lesson, Voy. Coquille, II, 94, pl. 6, 1830, **Waigiu.**

ORECTOLOBUS Bonaparte. (*Crossorhinus* Muller & Henle.)

6. **Orectolobus barbatus** (Gmelin). New Guinea (Macleay); Australia; Japan.

7. **Orectolobus dasypogon** (Bleeker). Waigiu; Alu.

Crossorhinus dasypogon Bleeker, Archiv Neerl. 1867, 400, with plate, **Waigiu.**

If this species is really different from the Australian *O. barbatus*, it is probable that Japanese as well as Melanesian specimens belong to it.

Family GINGLYMOSTOMATIDÆ.

NEBRIUS Rüppell.

8. **Nebrius concolor** Rüppell. New Guinea (Macleay); Indian Seas.

GINGLYMOSTOMA Müller & Henle.

9. **Ginglymostoma ferrugineum** (Lesson). New Ireland; Waigiu; India.

Scyllium ferrugineum Lesson, Voy. Coquille, II, 95, 1824.
Ginglymostoma mulleri Günther, Cat., VIII, 408, 1870.

Family CARCHARIIDÆ. *Malie; Tanifa.*

GALEUS Rafinesque.

10. **Galeus japonicus** Müller & Henle. Laysan; Japan.

GALEOCERDO Müller & Henle.

11. **Galeocerdo tigrinus** Müller & Henle. Hawaii; Australia; Japan.

TRIÆNODON Müller & Henle.

12. **Triænodon obesus** (Rüppell). Aneiteum; East Indies.

PRIONACE Cantor.

13. **Prionace glauca** (Linnæus). Hawaii; warm seas.

CARCHARIAS Rafinesque.

14. **Carcharias melanopterus** Quoy & Gaimard. *Malie alamata.* Waigiu; Thornton I.; Christmas I.; Washington I.; Hawaii; Samoa.

This species, known at once by the jet black tips to its fins, is the commonest shark in the channels between the reefs of Samoa.

15. **Carcharias phorcys** Jordan & Evermann. Hawaii.
16. **Carcharias insularum** Snyder. Hawaii.
17. **Carcharias nesiotes** Snyder. Hawaii; Laysan; French Frigate Shoals.
18. **Carcharias sorrah** Müller & Henle. Solomon Is. (Seale); East Indies.
19. **Carcharias maou** (Lesson). Paumotu Is.

Squalus maou Lesson, Voy. Coquille, II, 91, pl. 1, 1830, **Paumotu Is.**

20. **Carcharias pleurotænia** Bleeker. New Guinea (Bleeker); East Indies.

HYPOPRIONODON Gill.

21. **Hypoprionodon macloti** (Müller & Henle). New Guinea (Bleeker); East Indies.

Family SPHYRNIDÆ.

SPHYRNA Rafinesque.

22. **Sphyrna zygæna** (Linnæus). *Mata-i-taliga.* Samoa; Hawaii; Fiji; New Guinea; warm seas.

The common hammerhead is abundant at the reefs of Samoa, as also at Hawaii. Two specimens preserved from Apia.

Family ALOPIIDÆ.

ALOPIAS Rafinesque.

23. **Alopias vulpes** (Gmelin). Hawaii; warm seas.

Family LAMNIDÆ.

ISUROPSIS Gill.

24. **Isuropsis glauca** (Müller & Henle). Hawaii; tropical Pacific.

CARCHARODON Smith.

25. **Carcharodon carcharias** (Linnæus). Hawaii; warm seas.

Family SQUALIDÆ.

SQUALUS Linnæus.

26. **Squalus mitsukurii** Jordan & Snyder. Hawaii; Japan.

ETMOPTERUS Rafinesque.

27. **Etmopterus villosus** Gilbert. Deep waters of Hawaii.

CENTROSCYLLIUM Müller & Henle.

28. **Centroscyllium ruscosum** Gilbert. Deep waters of Hawaii.

ISISTIUS Gill.

29. **Isistius brasiliensis** (Quoy & Gaimard). South Pacific, off Fiji; Brazil; Guinea.

Family RHINOBATIDÆ.

RHINOBATUS Bloch & Schneider.

30. **Rhinobatus granulatus** Cuvier. New Guinea; Bougainville Is.; East Indies.
31. **Rhinobatus thouini** Müller & Henle. Hood Bay, New Guinea (Macleay).
32. **Rhinobatus joram** Montrouzier. Louisiades.

Rhinobatus joram Montrouzier, Ann. Soc. Lyons, 1856, 220, **Woodlark I. (Louisiades).**

Family DASYATIDÆ.

DISCOBATIS Macleay & Macleay.

This genus is near *Urolophus*, but has no fin on the tail. The skin is smooth, the disk circular, the ventrals entire, and the teeth small. (Not *Discobatus* Garman 1880, a Japanese genus.)

33. **Discobatis marginipinnis** Macleay & Macleay. Admiralty Is.

Discobatis marginipinnis Macleay & Macleay, Proc. Linn. Soc. N. S. W. 1885, 676, pl. 46.

DASYATIS Rafinesque.

34. **Dasyatis sciera** Jenkins. Hawaii.
35. **Dasyatis lata** Garman. Hawaii.
36. **Dasyatis hawaiiensis** Jenkins. Hawaii.
37. **Dasyatis kuhli** (Müller & Henle). New Ireland; East Indies.
38. **Dasyatis trigonoides** (Castelnau). New Caledonia.

Raya (Neotrygon) trigonoides Castelnau, Proc. Zool. Soc. Vict. 1873, 121, **New Caledonia; a sting ray with the spine wanting.**

TÆNIURA Müller & Henle.

Tail long, with a rayless fold of skin below.

39. Tæniura lymma (Forskål). New Guinea (Macleay); East Indies.

40. Tæniura atra Macleay. New Guinea (Macleay).

HIMANTURA Duméril.

Tail very long, without fold.

41. Himantura fai Jordan & Seale, new species. *Fai.* Samoa.

Snout 4.80 to base of tail; eye 2.75 in interorbital space, which is equal to snout; length of nasal opening 2.75 in interorbital.

Body broadly pentagonal, the snout very broad but somewhat pointed; disk wider than long (14.50 inches wide, 11.50 long); length of disk 3.30 times in the long whip-like tail; teeth not large, about 13 oblique series on upper jaw and 23 oblique series in lower; upper buccal flap with fine fringes; width of mouth 1.75 in snout; distance between lower gill-openings equal to distance from first to fifth opening; length of ventral fins slightly less than interorbital space; tail without fold of any kind, its lower surface smooth, the upper surface with scattered small prickles (spine removed by fisherman from type); a row of 10 large spinules in front of spine; seven small spines on median line of disk at its highest joint; a few scattered minute spicules scarcely showing through the skin near these spines and on interorbital region, otherwise disk perfectly smooth.

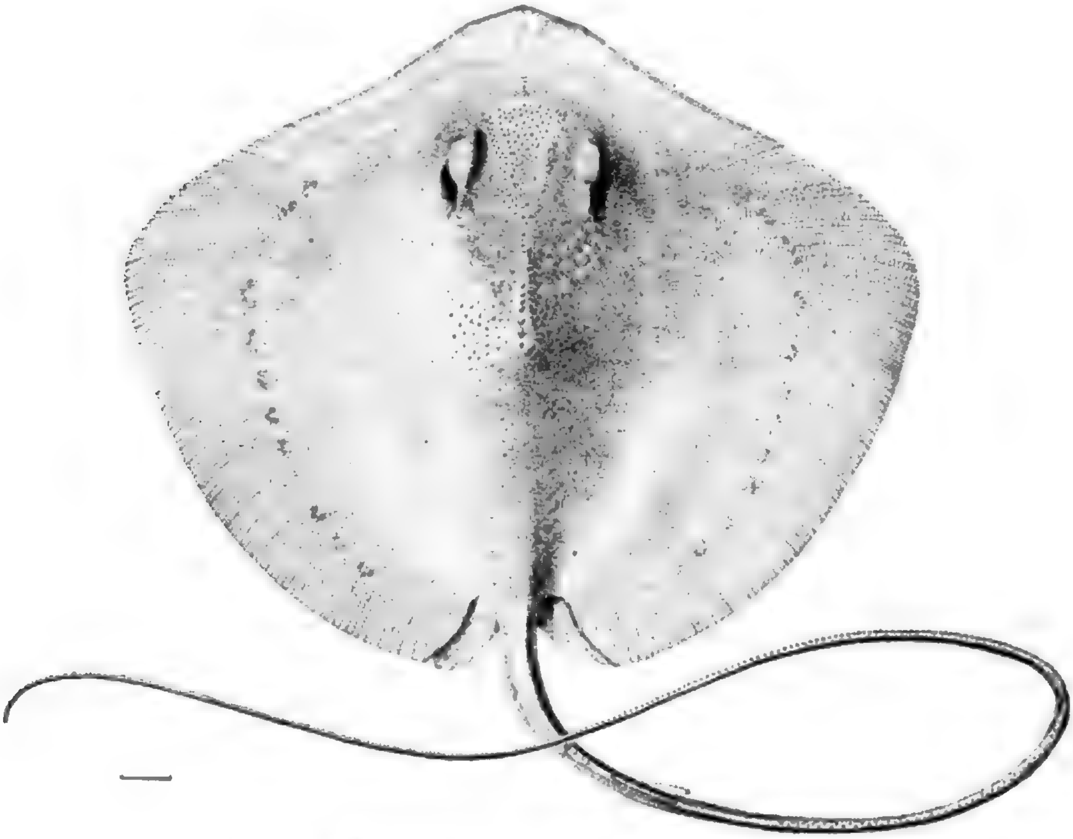

FIG. 2.—*Himantura fai* Jordan & Seale, new species. Type.

Color in spirits, back a uniform drab, top of tail dusky, under surface of disk uniform white, under surface of tail light brown.

One specimen, type no. 51712, U. S. National Museum, from Apia, Samoa. Length with tail 47 inches. The color in life was plain brown, not very dark, white below, with no reddish shades and no ocelli. The species is allied to *Himantura uarnak*, but the latter species has the disk considerably narrower.

42 **Himantura uarnak** (Forskål). New Ireland; East Indies.

43. **Himantura granulata** (Macleay). New Guinea.

Trygon granulatus Macleay, Proc. Linn. Soc. N. S. W. 1883, 598. **S. E. New Guinea.**

HYPOLOPHUS Duméril.

44. **Hypolophus sephen** (Forskål). New Britain; East Indies.

Family AETOBATIDÆ.

AETOBATUS Blainville. (*Myliobatis* Müller & Henle.)

45. **Aetobatus punctatus** (Macleay & Macleay). Admiralty Is.

Myliobatis punctatus Macleay & Macleay, Proc. Linn. Soc. N. S. W. 1886, 675, pl. 46, fig. 1. **Admiralty Is.**

STOASODON Cantor. (*Aetobatis* Müller & Henle, not of Blainville.)

46. **Stoasodon narinari** (Euphrasen). Hawaii; Laysan; East Indies; West Indies.

Family MOBULIDÆ.

MOBULA Rafinesque.

47. **Mobula japonica** Müller & Henle. Hawaii; Japan.

48. **Mobula draco** (Günther). Misol.

Dicerobatis draco Günther, Voy. Curaçao, 412, 1873.

Family CHIMÆRIDÆ.

CHIMÆRA Linnæus.

49. **Chimæra purpurescens** Gilbert. Deep seas of Hawaii; Japan.

Family ELOPIDÆ.

ELOPS Linnæus.

50. **Elops saurus** Linnæus. Hawaii; Samoa; New Guinea; warm seas.

MEGALOPS Lacépède.

51. **Megalops cyprinoides** (Broussonet). Tahiti; Guam; Tubuai; Samoa; Papua; Fiji; New Hebrides (Seale); East Indies.

Megalops macropterus Bleeker, Ned. Tydschr. Dierk. 1866, 284, **East Indies.**

This widely diffused species is common at Samoa, inhabiting the river mouths and brackish pools in the shores. Most of our many specimens from Apia were taken in a pool in the village just east of the mouth of Vaisigano River, this pool being alternately filled by rain and by the surf in storms. None of these specimens is more than a foot long. They correspond perfectly to the *Megalops macropterus* of Bleeker, which is plainly the original *Clupea cyprinoides* of Broussonet. We much doubt the validity of any of the species detached from *Megalops cyprinoides* by Bleeker. In any case, the true *cyprinoides*, from Tahiti, is Bleeker's *macropterus*.

Family CHIROCENTRIDÆ.

CHIROCENTRUS Cuvier.

52. **Chirocentrus dorab** (Forskål). New Guinea; New Britain; East Indies.

Family CHANIDÆ.

CHANOS Cuvier.

53. Chanos chanos (Forskål). Hawaii; New Caledonia; Samoa; New Guinea; tropical Pacific.

Common along the shores inside the reefs of Samoa.

Family ALBULIDÆ.

ALBULA Gronow.

54. Albula vulpes (Linnæus). Tahiti; Tonga; Hawaii; New Guinea; warm seas.

Family CLUPEIDÆ.

ETRUMEUS Bleeker.

55. Etrumeus micropus (Schlegel). Hawaii; Japan.

STOLEPHORUS Lacépède. (*Spratelloides* Bleeker.)

56. Stolephorus delicatulus (Bennett). *Nefu.* Samoa; East Indies.

About 20 specimens of this fragile little fish were taken inside the reefs of Apia and Pago Pago. Color in life, deep sky blue, sides silvery.

DUSSUMIERIA Cuvier & Valenciennes.

57. Dussumieria acuta Cuvier & Valenciennes. New Guinea (Macleay); East Indies.

CORICA Gray. (*Clupeoides* Bleeker.)

58. Corica papuensis Ramsay & Ogilby. New Guinea.

Corica papuensis Ramsay & Ogilby, Proc. Linn. Soc. N. S. W, 1886, 19, Strickland River (New Guinea).

SARDINELLA Cuvier & Valenciennes.

(*Amblygaster* Bleeker; *Sardinia* Poey.)

59. Sardinella sirm (Forskål). *I'a moana; Pelupelu.* Samoa; East Indies.

Clupea sirm Rüppell, Neue Wirbelthiere, 77, taf. 21, fig. 1, 1835, Red Sea. Günther, Cat., VII, 425, Zanzibar, Batavia.
Sardinella leiogastroides, Bleeker, Tijds. Ned. Ind., VII, 255, Manado; scales 45.

We have numerous specimens of a large sardine from the shores about Apia. It agrees closely with Günther's account of *Clupea sirm*, and must be the fish thus called by Günther. It has only a single dark spot behind the gill-opening, and the species with a series of such spots along the side (*leiogaster* and *punctata*) must be different. It is, of course, an excellent food-fish.

Life colors of a specimen from Pago Pago, deep blue above, somewhat streaky along rows of scales, abruptly silvery below; a small spot behind gill-opening; tips of jaws dusky; fins small, dusky above.

HARENGULA Cuvier & Valenciennes.

(*Kowala*, *Rogenia*, and *Clupeonia* Cuvier & Valenciennes; *Paralosa* Bleeker.)

60. Harengula commersoni (Cuvier & Valenciennes). *Pelupelu.* Vanicolo; Samoa; East Indies.

(?) *Clupea melanura* Cuvier, Règne Anim., ed. I, vol. II, p. 318, 1817, no description, obscure reference to Lacépède.
Clupeonia commersoni Cuvier & Valenciennes, Hist. Nat. Poiss., XX, 350, 1847, Pondicherry.
Clupeonia vittata Cuvier & Valenciennes, op. cit., 352, 1847, Vanicolo.
Harengula melanurus Bleeker, Nat. Tijds. Ned. Ind., V, 245.
Clupea atricauda Günther, Cat., VII, 426, 1869, Ceram, Amboina.

One fine specimen was taken at Apia. Life colors, caudal lobes jet black; back blue, blackish streaks along the rows of scales above, sides silvery white.

61. **Harengula gibbosa** (Bleeker). Fiji (Günther); East Indies.

62. **Harengula chrysotænia** (Bleeker). Tahiti; East Indies.

63. **Harengula vanicoris** Jordan & Seale, new name. Vanicolo; Papua; East Indies.

Alausa melanura Cuvier & Valenciennes, op. cit., 441, 1847, **Vanicolo**, New Guinea, Amboina; not *Clupea melanura* Cuvier.

Family DOROSOMATIDÆ.

ANODONTOSTOMA Bleeker.

Last ray of dorsal not produced.

64. **Anodontostoma breviceps** (Peters). Bismarck Is.; New Hanover; East Indies.

Chatoessus breviceps Peters, Berl. Mon. 1876, 848, **New Hanover, Bismarck Is.**, Amboina.

65. **Anodontostoma chacunda** (Hamilton-Buchanan). New Guinea (Macleay); East Indies.

KONOSIRUS Jordan & Snyder.

Last ray of dorsal filamentous, as in *Dorosoma*.

66. **Konosirus thrissa** (Linnæus). New Guinea; East Indies; China.

Chatoessus nasus (Bloch) Cuvier & Valenciennes.

Family ENGRAULIDÆ.

ANCHOVIA Jordan & Evermann.

67. **Anchovia purpurea** (Fowler). Hawaii.

68. **Anchovia apiensis** Jordan & Seale, new species. *Nefu.* Samoa.

Head 4.50 in body (to base of caudal); depth 5; eye 3.20 in head; snout 4.50; interorbital scarcely equal to eye; dorsal I, 13; anal I, 20; scales 34; maxillary elongate, 5 in length of head.

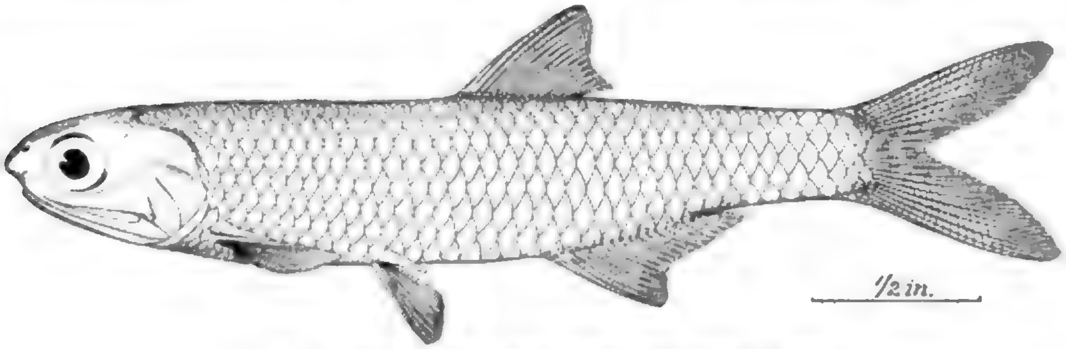

FIG. 3.—*Anchovia apiensis* Jordan & Seale, new species. Type.

Body oblong, compressed; snout produced, conical; mandible 1.45 in head; maxillary extending to posterior angle of preopercle; minute teeth in jaws, palatines, vomer, and pterygoids; gill-rakers 1.20 in eye, 30 on lower limb; insertion of dorsal nearer base of caudal than tip of snout by a distance equal to width of eye, its longest ray 1.20 in head; length of pectoral less than depth of body, 1.75 in head; insertion of ventrals equally distant between origin of pectorals and origin of anal; origin of anal under posterior third of dorsal, its base equal to distance from anterior margin of eye to posterior margin of opercle; caudal forked, its lobes equal to length of head; caudal peduncle rather deep, 2.20 in head; scales deciduous, the middle row of belly with spines.

Color in spirits white, the scales with silvery reflections, more or less punctulate with minute black dots on upper surface; cheeks and iris with gilt reflections; a dusky blotch on upper part of orbit, and on nuchal region; slight dusky shading along base of dorsal, anal, and upper base of caudal; caudal with a slight wash of dusky; other fins white. Life colors white, pale olive on back; a silvery lateral band.

Type no. 51720, U. S. National Museum, from Apia; length 3 inches. Of this small species, we have about a dozen fine specimens from the shores inside the reef at Apia.

69. Anchovia evermanni Jordan & Seale, new species. *Nefu.* Samoa.

Head 4 in length; depth 4.50; eye 3.75 in head; snout 1.75; dorsal i, 13; anal i, 30; scales 34; interorbital space equal to eye; maxillary equal to depth of fish, 4.50 in length.

Body elongate, compressed; scales large and deciduous; belly trenchant, the scales of middle row each ending in a sharp spine; snout projecting, conical; origin of dorsal midway between tip of snout and base of caudal, its longest ray equal to distance from middle of eye to posterior margin of opercle; pectoral inserted low and extending to base of ventrals, the length 1.50 in head; ventrals 2 in head, their origin nearer pectoral than base of anal; origin of anal posterior to base of dorsal, its length equal to head; caudal deeply forked, the lobes equal to length of head; numerous small teeth on the pterygoids, palatines, vomer and jaws; maxillary extending to posterior angle of preopercle, and bearing a single row of fine teeth; gillrakers scarcely equal to eye, 23 on the lower limb.

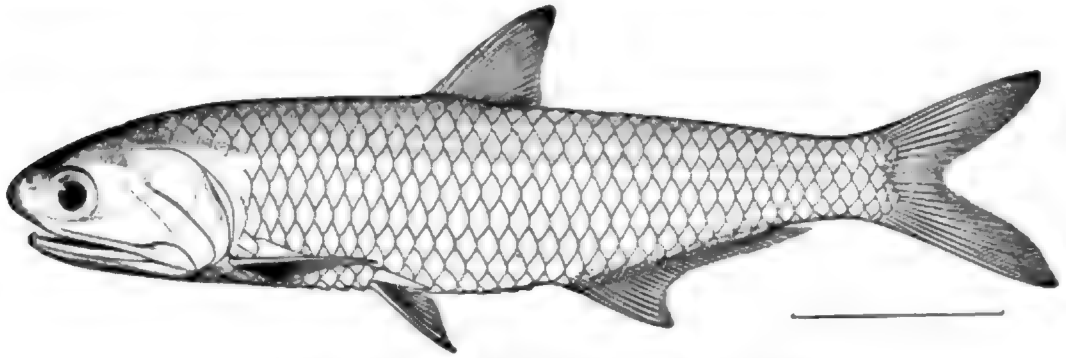

Fig. 4.—*Anchovia evermanni* Jordan & Seale, new species. Type.

Color in spirits, silvery, darker above, with a bluish wash; a golden wash on cheek; a dusky blotch on upper margin of orbit; fins all yellowish white, the caudal with an indistinct tip of dusky on end of lobes. In life one specimen had an orange blotch behind gill-opening above, dorsal and caudal chiefly light orange-brown, no silvery lateral band.

Five specimens, from Apia; type no. 51719, U. S. National Museum, 5 inches long. In all these specimens the depth is 4.66 to 4.75 in the length, instead of 4 times, as stated by Bleeker and Günther of *Anchovia bælama*, the nearest known species.

This species is named for Dr. Barton Warren Evermann.

70. Anchovia scratchleyi (Ramsay & Ogilby). New Guinea.

Engraulis scratchleyi Ramsay & Ogilby, Proc. Linn. Soc. N. S. W. 1886, 18, **Strickland River (New Guinea).**

71. Anchovia enchrasicoloides (Bleeker). New Guinea (Macleay); East Indies.

Family AULOPIDÆ.

CHLOROPHTHALMUS Bonaparte.

72. Chlorophthalmus proridens Gilbert & Cramer. Deep waters of Hawaii.

Family SYNODONTIDÆ.

SYNODUS Bloch & Schneider.

73. Synodus varius Lacépède. Hawaii; Samoa; New Guinea; Fiji; Mangareva (Seale); Japan.

A few specimens of this widely diffused species were taken at Samoa, on the shore within the reef.

74. Synodus kaianus Günther. Deep seas of Hawaii; Arafura Sea.

TRACHINOCEPHALUS Gill.

75. Trachinocephalus myops Forster. Hawaii; warm seas.

SAURIDA Cuvier.

76. **Saurida gracilis** (Quoy & Gaimard). Hawaii; Samoa; New Guinea; Solomon Is. (Seale).

Two specimens were taken in the seine at Apia. They are more deeply colored than Hawaiian examples, but are not otherwise different. This species is common about Hawaii.

77. **Saurida grandisquamis** Günther. Louisiades; Australia.

78. **Saurida tumbil** (Bloch). Vanicolo; Waigiu; East Indies.

Family BRACHYPTEROIDÆ.

BRACHYPTEROIS Günther.

79. **Brachypterois antennatus** Gilbert. Deep seas of Hawaii.

Family MYCTOPHIDÆ.

DASYSCOPELUS Günther.

80. **Dasyscopelus asper** (Richardson). New Ireland.

81. **Dasyscopelus stellatus** (Bennett). Open Pacific.

Scopelus stellatus Bennett, Whaling Voyage, II, 288, open Pacific.

82. **Dasyscopelus pristilepis** Gilbert & Cramer. Deep seas of Hawaii.

83. **Dasyscopelus spinosus** (Lütken). Deep seas of Hawaii.

NANNOBRACHIUM Günther.

84. **Nannobrachium nigrum** Gilbert. Deep seas of Hawaii.

MYCTOPHUM Rafinesque.

85. **Myctophum fibulatum** Gilbert & Cramer. Deep seas of Hawaii.

86. **Myctophum margaritatum** Gilbert. Deep seas of Hawaii.

87. **Myctophum lutkeni** Gilbert. Deep seas of Hawaii.

88. **Myctophum evermanni** Gilbert. Deep seas of Hawaii.

RHINOSCOPELUS Lütken.

89. **Rhinoscopelus oceanicus** Jordan & Evermann. Deep seas to the southward of Hawaii.

DIAPHUS Eigenmann. (*Æthoprora* Goode & Bean.)

90. **Diaphus urolampus** Gilbert & Cramer. Deep seas of Hawaii.

91. **Diaphus chrysorhynchus** Gilbert & Cramer. Deep seas of Hawaii.

92. **Diaphus adenomus** Gilbert. Deep seas of Hawaii.

CENTROBRANCHUS Fowler.

93. **Centrobranchus chœrocephalus** Fowler. Deep seas of Hawaii.

94. **Centrobranchus gracilicaudus** Gilbert. Deep seas of Hawaii.

NEOSCOPELUS Johnson.

95. **Neoscopelus alcocki** Jordan & Starks. Deep seas of Hawaii; Japan.

Family MAUROLICIDÆ.

ZALARGES Jordan & Starks.

96. **Zalarges nimbarius** Jordan & Starks. Open sea between Hawaii and Seattle.

Family GONOSTOMIDÆ.

CYCLOTHONE Goode & Bean.

97. **Cyclothone rhodadenia** Gilbert. Deep seas of Hawaii.

98. **Cyclothone canina** Gilbert. Deep seas of Hawaii.

GONOSTOMA Rafinesque.

99. **Gonostoma elongatum** Günther. Deep water off New Guinea.

Gonostoma elongatum Günther, Challenger Rept., 186, 1887, **New Guinea.**

Family STOMIIDÆ.

STOMIAS Risso.

100. **Stomias boa** Risso. Mid-Pacific; Mediterranean.

Stomias boa, Peters, Berl. Mon. 1876, 846, 149° 26′ W., mid-Pacific.

ASTRONESTHES Richardson.

101. **Astronesthes lucifer** Gilbert. Deep seas of the Pacific.

Family IDIACANTHIDÆ.

IDIACANTHUS Peters.

102. **Idiacanthus fasciola** Peters. Open Pacific.

Idiacanthus fasciola Peters, Berl. Mon. 1876, 846, **north of New Guinea,** 1° 45′ S., 136° W.

Family STERNOPTYCHIDÆ.

STERNOPTYX Herrmann.

103. **Sternoptyx diaphana** Herrmann. Deep seas of Hawaii; deep seas.

POLYIPNUS Günther.

104. **Polyipnus nuttingi** Gilbert. Deep seas of Hawaii.

ARGYRIPNUS Günther.

105. **Argyripnus ephippiatus** Gilbert & Cramer. Deep seas of Hawaii.

ARGYROPELECUS Cocco.

106. **Argyropelecus heathi** Gilbert. Deep seas of Hawaii.

DIPLOPHOS Günther.

107. **Diplophos pacificus** Günther. Mid-Pacific.

Family PARALEPIDÆ.

LESTIDIUM Gilbert.

108. **Lestidium nudum** Gilbert. Deep seas of Hawaii.

NEOSUDIS Castelnau.

109. **Neosudis vorax** Castelnau. New Caledonia.

Neosudis vorax Castelnau, Proc. Zool. Soc. Vict. 1878, 118, **Noumea (New Caledonia).**

Family HALOSAURIDÆ.

ALDROVANDIA Goode & Bean. (*Halosauropsis* Collett.)

110. **Aldrovandia kauaiensis** Gilbert. Deep waters of Hawaii, Kauai I.

111. **Aldrovandia proboscidea** Gilbert. Deep seas of Hawaii.

112. **Aldrovandia verticalis** Gilbert. Deep seas of Hawaii.

Family PLOTOSIDÆ.

PLOTOSUS Lacépède.

113. **Plotosus anguillaris** Bloch. *Apou.* Samoa; Waigiu; New Guinea; Solomon Islands (Seale); Asia; East Indies.

Plotosus ikapor Lesson, Voy. Coquille, Zool. II, 132, pl. 31, fig. 3, 1830, **Waigiu.**

This little catfish is occasionally taken in shallow water inside the reef at Apia. The yellow stripes on the sides are very faint or wanting in our specimens, which otherwise do not seem to differ at all from specimens from Nagasaki. We therefore place the species of the South Seas (*Plotosus ikapor*, described first from Waigiu) in the synonymy of *Plotosus anguillaris.*

Color dark olive, mottled, white below; sides with scarcely a trace of pale stripes; fins dusky, especially on the edges. Young individuals more distinctly marked, with two white stripes.

CNIDOGLANIS Günther.

114. **Cnidoglanis macrocephalus** (Cuvier & Valenciennes). New Guinea (Macleay); Timor.

TACHYSURUS Lacépède.

115. **Tachysurus græffi** (Kner & Steindachner).

Arius græffi Kner & Steindachner, Sitz. Ak. Wiss. Wien, 1867, 28, **Samoa.**

This species is described from Samoa. Perhaps the specimen is not Samoan, but came from the East Indian region, where catfishes of this type are abundant.

116. **Tachysurus armiger** (De Vis). New Britain.

Arius armiger De Vis, Proc. Linn. Soc. N. S. W. 1884, 454, **New Britain.**

GALEICHTHYS Cuvier & Valenciennes.

117. **Galeichthys froggatti** (Ramsay & Ogilby). New Guinea.

Arius froggatti Ramsay & Ogilby, Proc. Linn. Soc. N. S. W. 1886, 15, **Strickland River (New Guinea).**

118. **Galeichthys latirostris** (Macleay). New Guinea.

Arius latirostris Macleay, Proc. Linn. Soc. N. S. W. 1884, 276.

NETUMA Bleeker.

119. **Netuma spatula** (Ramsay & Ogilby). New Guinea.

Arius spatula Ramsay & Ogilby, op. cit., 16, **Strickland River (New Guinea).**

120. **Netuma thalassina** (Rüppell). New Guinea (Macleay); East Indies.

HEMIPIMELODUS Bleeker.

121. **Hemipimelodus dayi** Ramsay & Ogilby. Strickland River, New Guinea.

122. **Hemipimelodus crassilabris** Ramsay & Ogilby. Strickland River, New Guinea.

LAMBERTIA Perugia.

123. **Lambertia atra** Perugia. New Guinea.

Lambertia atra Perugia, Ann. Mus. Genova 1894, 550, **East New Guinea.**

Family ANGUILLIDÆ.

ANGUILLA Thunberg. *Tuna.*

124. **Anguilla mauritiana** Bennett. *Tuna tafa'i-lautalo; Tuna gatala.* Waigiu; Tahiti; Samoa, in rivers; Johanna I.; Levuka and Ovalau; Fiji (Günther); East Indies.

> *Anguilla mauritiana* Bennett, Proc. Comm. Zool. Soc. 1831, 128, **Mauritius.** Günther, Cat., VIII 26, Amboina, Ceylon, Philippines, Formosa, Almorah, Johanna I. Günther, Shore Fishes, Challenger, 1880, 58, Lake Waiheira (Tahiti).
> *Anguilla marmorata* Quoy & Gaimard, Voy. Uranie, 1824, 241, **Waigiu.**
> *Muræna marmorata* Kner, Novara Fische, 369, Tahiti, Hongkong.
> *Anguilla labrosa* Richardson, Voy. Erebus and Terror, 113, 1846, South Seas.
> *Muræna maculata* Bleeker, Atlas, Murænidæ, 9, tab. 1, fig. 2, East Indies; not of Lacépède.
> *Anguilla johannæ* Günther, Fish. Zanzibar, 124, **Johanna I.**

This species is the commonest eel of the Samoan Islands, abounding in quiet waters in all the streams, and reaching a considerable size. We have about 20 specimens, mostly from Vaisigano River. The species varies considerably in the insertion of the dorsal, which is always well forward, however. The body is always finely mottled or marbled, hence the vernacular name of *tuga tafailotalo*, or "eel colored like [boiled] taro."

Life colors of one specimen from Apia, dark brown, everywhere reticulate with darker. Another was mottled olive and black; dorsal and anal edged with pale.

125. **Anguilla fidjiensis** Günther. Rivers of Fiji.

> *Anguilla fidjiensis* Gunther, Cat., VIII, 26, 1870, **Kandavu and Nairi (Fiji).**

This species, which we have not seen, is very close to *Anguilla mauritiana*, and seems within the limits of variation of that species.

126. **Anguilla obscura** Günther. Fiji.

> *Anguilla obscura* Günther, Proc. Zool. Soc. Vict. 1871, 673, **Fiji.**

127. **Anguilla otaheitensis** Kaup. Tahiti.

> *Anguilla otaheitensis* Kaup, Aale Hamb. Mus. 17, **Tahiti.**

128. **Anguilla megastoma** Kaup. *Tuna mea.* Mangareva; Aneiteum; Tahiti; Samoa; Rarotonga; Tubuai; Austral Is.; Nukahiva, Marquesas Is. (Seale).

> *Anguilla megastoma* Kaup, Apodes 30, **Megareva.**
> *Anguilla aneitensis* Günther, Cat., VIII, 34, 1870, **Aneiteum.** Gunther, Shore Fishes, Challenger, 1880, 58, Lake Waiheira (Tahiti).

This species is uniformly colored above, pale below, with the dorsal well forward, though less advanced than in *Anguilla mauritiana;* the teeth in very broad bands, the vomerine band narrower than the maxillary bands. We have two specimens from the Vaisigano River at Apia. Kaup's type is said to come from Megarava, which is evidently a misprint for Mangareva, one of the Gambier Islands.

Life colors of a specimen from Apia, yellow brown, belly and dorsal yellow; fine yellow dots on lateral line. Much paler and more yellow than *Anguilla australis.* Dorsal fin more advanced.

129. **Anguilla sidat** Bleeker. Samoa; New Zealand.

The species seems to differ from *Anguilla australis* in having the maxillary extending beyond the eye, the vomerine teeth also extending backward almost as far as the maxillary teeth. We have one large specimen from Samoa answering to the description of this species. Were it not for the much longer maxillary we should think this the adult of *Anguilla australis.*

Life colors of a specimen from Apia, plain dark brown, yellow below; dorsal grayish dusky. Dorsal posterior.

130. **Anguilla australis** Richardson. Samoa; New Zealand; East Indies.

Of this species we have half a dozen young from the streams (Vaisigono, Gasegase) about Apia. They seem to agree perfectly with *Anguilla australis*, having the dorsal inserted a little before vent and the vomerine band of teeth considerably shorter than the maxillary band.

Family SYNAPHOBRANCHIDÆ.

SYNAPHOBRANCHUS Johnson.

131. **Synaphobranchus brachysomus** Gilbert. Deep seas of Hawaii.

Family LEPTOCEPHALIDÆ.

LEPTOCEPHALUS Gmelin.

132. **Leptocephalus marginatus** Valenciennes. *Pusi solasulu.* Hawaii; Samoa; New Guinea; East Indies.

This conger eel, common throughout the Pacific, is abundant both at Samoa and Honolulu. It is easily known by the black blotch on the pectoral fin. We have 8 examples from Samoa.

CONGRELLUS Ogilby.

133. **Congrellus bowersi** Jenkins. Hawaii.

134. **Congrellus neo-guinaicus** (Bleeker). New Guinea.

135. **Congrellus fijiensis** Ogilby. Fiji.

Congrellus fijiensis Ogilby, Proc. Lin. Soc. N. S. W. 1898, 288, Fiji.

136. **Congrellus guttulatus** (Günther). Samoa; Fiji.

One specimen from Apia. Life colors, light olive, with dark cross-shades; pectoral plain; vertical fins with broad dark edge; an oblique olive shade before eye.

137. **Congrellus æquoreus** Gilbert & Cramer. Deep seas of Hawaii.

PROMYLLANTOR Alcock.

138. **Promyllantor alcocki** Gilbert & Cramer. Deep seas of Hawaii.

METOPOMYCTER Gilbert.

139. **Metopomycter denticulatus** Gilbert. Deep seas of Hawaii.

VETERNIO Snyder.

140. **Veternio verrens** Snyder. Hawaii.

Family MURÆNESOCIDÆ.

MURÆNESOX McClelland.

141. **Murænesox cinereus** (Forskål). Hood Bay; New Guinea; East Indies.

Family MYRIDÆ.

MURÆNICHTHYS Bleeker.

142. **Muræniehthys macropterus** Bleeker. New Caledonia; East Indies.

MYROPTERURA Ogilby.

143. **Myropterura laticaudata** Ogilby. Fiji.

Myropterura laticaudata Ogilby, Proc. Linn. Soc. N. S. W., 1897, 247, Fiji.

Family NEMICHTHYIDÆ.

NEMICHTHYS Richardson.

144. **Nemichthys scolopaceus** Richardson. North of Papua in deep water; open seas.

Nemichthys scolopaceus, Peters, Berl. Mon. 1876, 849, north of Papua in deep water.

SERRIVOMER Gill & Ryder.

145. **Serrivomer beani** Gilbert. Deep seas of Hawaii.

STEMONIDIUM Gilbert.

146. **Stemonidium hypomelas** Gilbert. Deep seas of Hawaii.

NEMATOPRORA Gilbert.

147. **Nematoprora polygonifera** Gilbert. Deep seas of Hawaii.

Family OPHICHTHYIDÆ.

SPHAGEBRANCHUS Bloch.

148. **Sphagebranchus flavicaudus** Snyder. Maui, Hawaii.

DALOPHIS Rafinesque.

149. **Dalophis longipinnis** (Kner & Steindachner). Samoa.

This small species, very slender in form and having the dorsal inserted in advance of the gill-opening, is known to us from a very young example taken at Apia.

150. **Dalophis misolensis** (Günther). Misol.

Ophichthys misolensis Gunther, Ann. Mag. Nat. Hist., x, 1872, 426, **Misol.**

MICRODONOPHIS Kaup.

151. **Microdonophis fowleri** Jordan & Evermann. Hawaii.

152. **Microdonophis macgregori** Jenkins. Hawaii.

153. **Microdonophis polyophthalmus** Bleeker. Hawaii; East Indies.

This species differs from the type of *Microdonophis* in having the dorsal inserted over the middle of the head. The body is uniformly colored.

BASCANICHTHYS Jordan & Davis.

154. **Bascanichthys pinguis** Günther. Solomon Islands.

Ophichthys pinguis Günther, Ann. Mag. Nat. Hist., x, 1872, 425, **Solomon Islands.**

CALLECHELYS Guichenot.

155. **Callechelys luteus** Snyder. Molokai, Hawaiian Islands.

156. **Callechelys filaris** (Günther). Misol.

Ophichthys filaris Gunther, Ann. Mag. Nat. Hist., x, 1872, 425, **Misol.**

LEIURANUS Bleeker.

157. **Leiuranus semicinctus** (Lay & Bennett). *'Ata'ata uli.* Hawaii; Japan; East Indies.

Of this species we have one large specimen from Apia. Its coloration is wonderfully close to that of *Chlerastes colubrinus*, but the black bands are broader than in the latter, and most of them do not meet the fellow on the belly. This species is widely diffused, occurring in company with the two species of *Chlerastes*, both of which are colored remarkably like it.

158. **Leiuranus cobra** (De Vis). South Seas.

Ophichthys cobra De Vis, Proc. Linn. Soc. N. S. W., 1884, 455, **South Seas.**

This species is said to have the head one-tenth of the length of the trunk. In other respects it agrees with *Leiuranus semicinctus*, with which it is probably identical.

BRACHYSOMOPHIS Kaup.

159. Brachysomophis henshawi Jordan & Snyder. Honolulu.

160. Brachysomophis crocodolinus (Bennett). Tahiti; Mauritius.

MYRICHTHYS Girard.

161. Myrichthys stypurus Smith & Swain. Johnston I.

162. Myrichthys magnificus (Abbott). Hawaii.

CHLEVASTES Jordan & Snyder.

163. Chlevastes colubrinus (Boddaert). Samoa; Guam; East Indies.

A few specimens from Samoa.

164. Chlevastes fasciatus (Ahl). Samoa; East Indies.

Muræna fasciata Ahl, De Muræna et Ophichtho, 1789, 9, **East Indies.**
Ophichthys colubrinus fasciatus Günther, Cat., VIII, 81, 1870, Borneo.
Ophichthys naja De Vis, Proc. Linn. Soc. N. S. W. 1884, 455, **South Seas.**

This species seems to us distinct from *Chlevastes colubrinus*. The head is shorter, 9 to 11 times in the length of the trunk (7 to 8 in *Chlevastes colubrinus*). The black cross-bands are less regularly formed, having backward projections, and there is in the pale interspace usually a large rounded black spot or ocellus.

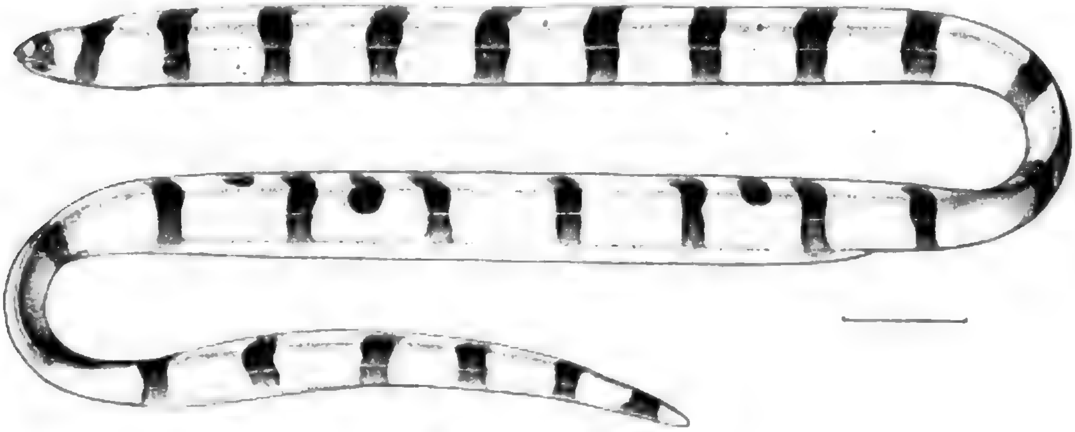

FIG. 5.—*Chlevastes fasciatus* (Ahl).

We have two large examples from the coral reef at Apia.

Family MORINGUIDÆ.

MORINGUA Gray. (Including *Aphthalmichthys* Kaup.)

165. Moringua hawaiiensis Snyder. Honolulu.

166. Moringua macrocephala Bleeker. Samoa; East Indies.

Of this rare species, distinguished by its long head, we have one fine specimen from the harbor of Pago Pago. Depth 4 in head; head 9 in total length; pectoral minute, scale-like; gill-openings separate.

Life colors light pinkish brown, nearly uniform; head very clear translucent rosy red; caudal more orange.

This specimen was taken in salt water at the mouth of a little brook and was very tenacious of life.

167. Moringua javanica (Kaup). Fiji; Moluccas.

Family MURÆNIDÆ.

RHINAMURÆNA Garman.

This genus differs from *Eurymyctera* in having the anterior nostrils slit and dilated at the ends, which are produced into long flaps.

168. Rhinamuræna quæsita Garman. Marshall Is.

Rhinamuræna quæsita Garman, Bull. Essex Inst. 1889, 114. **Marshall Is.**

169. Rhinamuræna eritima Jordan & Seale, new species. Samoa.

Head 7.20 in total length, 2.65 in body anterior to vent; depth 2 in head; vent exactly midway between tip of snout and tip of tail; length of snout, from posterior nostril, 5.20 in head; eye 2 in snout; angle of jaws 2.20 in head; jaws curved and can not be completely closed; dorsal high 4.60 in head; anal about one-half as high as dorsal; origin of anal immediately posterior to vent; origin of dorsal about midway between gill-openings and angle of jaws; gill-openings size of eye; anterior nostrils on end of snout long, about equal to eye, terminating in an expanded disk two-thirds as wide as eye; posterior nostrils consisting of slightly elevated tubes situated on upper side of snout directly above anterior margin of eye; top of snout flat with a narrow concave groove; depth of snout at anterior margin of eye slightly less than width; forehead evenly rounded from posterior of eyes; teeth in lower jaw in a single row of 25 sharp, concave teeth on each side, the anterior five being enlarged; posterior teeth of upper jaw small and uniserial, the anterior teeth large biserial canines, three of which are on the median line of vomer; a single row of blunt palatine teeth; throat with numerous longitudinal wrinkles.

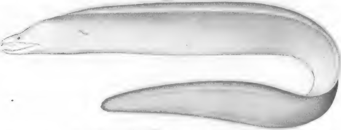

FIG. 6.—*Rhinamuræna eritima* Jordan & Seale, new species. Type.

Life colors, light-grayish brown, paler below; dorsal dusky with a sharply defined bluish white edge; anal with a faint pale edge. Color in spirits earth-brown, yellowish on belly and under part of head, dorsal and anal with distinct white margins, that of the dorsal broader, the posterior third of dorsal shading into an intermarginal black area, a yellowish wash on head posterior to eye.

This very handsome eel is known to us from a single specimen 20.15 inches long, taken at Pago Pago. Type no. 51717, U. S. National Museum.

MURÆNA Linnæus.

170. Muræna kailuæ Jordan & Evermann. Hawaii.

Muræna pardalis Bleeker, Atlas, Murænidæ, 86, pl. 25, figs. 1 and 2, Java, Cocos; probably not *Muræna pardalis* of Schlegel, a Japanese species.
Muræna kailuæ Jordan & Evermann, Bull. U. S. Fish Comm., XXII, 1902 (1903), 165, **Kailua (Hawaii).**
Muræna lampra Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (1903), 423, fig. 3, **Honolulu.**
Muræna kauila Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (1903), 424, fig. 4, **Honolulu.**

This species is rather common about the Hawaiian reefs, but was not seen at Samoa. The receipt of additional specimens from Honolulu forces us to believe that the variation in the arrangement of spots in this species is very great. If *M. kauila* and *M. lampra* are distinct species, we must add still two more to the list. The species is very close to the Japanese *Muræna pardalis* Schlegel, and may prove to be a variation of the latter, as Bleeker has supposed. In *Muræna kailuæ* the white spots on the belly are larger than in the Japanese species.

The life coloration of this species is very bright and attractive.

171. Muræna pavonina Richardson. South Seas.

Muræna pavonina Richardson, Voyage Sulphur, 110, pl. 53, figs. 1-6, **South Seas.**

ENCHELYNASSA Kaup.

172. Enchelynassa canina (Quoy & Gaimard). Hawaii; Samoa; Rawak; Waigiu.

Muræna canina[a] Quoy & Gaimard, Voy. Uranie, 247, 1824, **Rawak, Waigiu.**
Enchelynassa bleekeri Kaup, Apodes, 72, fig. 55, 1851; locality unknown. Jordan & Snyder, Proc. U. S. Nat. Mus., XXVII, 1904, 941, Hawaii.
Gymnothorax vinolentus Jordan & Evermann, Bull. U. S. Fish Comm., XXII, 1902 (1903), 165, **Kailua (Hawaii).**

Of this species 3 specimens are known besides the original type. These are the type of *G. vinolentus* from Hawaii, a very similar specimen now before us, from Samoa, and a very large example similar to Kaup's type, from Hawaii. It is one of the largest of the morays, and the most formidably armed.

EURYMYCTERA Kaup.

173. Eurymyctera acutirostris (Abbott). Hawaii.

Muræna acutirostris Abbott, Proc. Ac. Nat. Sci. Phila. 1860, 476, **Hawaii.**
Gymnothorax acutirostris Fowler, Proc. Ac. Nat. Sci. Phila. 1900, 494, plate 18, Hawaii, same specimen.

GYMNOTHORAX Bloch. *Pusi.*

174. Gymnothorax eupterus (Günther). Raoul I.

Muræna euptera Günther, Cat., VIII, 122, 1870, **Raoul I.**

175. Gymnothorax waialuæ Snyder. Hawaii.

Gymnothorax waialuæ Snyder, Bull. U. S. Fish Comm., XXII, 1902 (1904), 520, pl. 6, **Waialua (near Honolulu).**

This species is known from a young example taken by Professor Snyder. It is very close to the Japanese-East Indian species, *Gymnothorax reticularis*, but the arrangement of the sharply defined black cross-bands is different, and the interspaces between the bands are pale, as in *Chlevastes colubrinus.*

176. Gymnothorax petelli (Bleeker). Hawaii; Samoa; East Indies.

Muræna petelli Bleeker, Nat. Tijds., XI, 84, **Java.** Günther, Cat., VIII, 105, Java, Mauritius.
Gymnothorax petelli, Bleeker, Atlas, Murænidæ, 99, tab. XXXII, fig. 1.
Muræna interrupta Kaup, Apodes, 67, fig. 51, 1854, **Red Sea.**
Gymnothorax leucacme Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (1903), 427, fig. 7, **Honolulu.**

Of this handsome species we have 7 large specimens from Pago Pago and Apia. They agree entirely with the accounts both of *petelli* and *leucacme.*

Life colors of a specimen from Apia, dark brown, with 19 to 22 broad black cross-bars about as wide as the interspaces; fins barred like body; interspaces on anal whitish, some of the dark bands reaching the fin, others not; interspaces on dorsal pale, whitish on edge, each interspace with a large marginal black spot; tip of the tail white (sometimes black); angle of mouth black; belly light brown, the bands anteriorly not meeting across it (a dark spot sometimes between each pair of bands).

177. Gymnothorax meleagris (Shaw). Samoa; Fiji; East Indies.

Muræna meleagris Shaw, Nat. Misc., pl. 220, about 1802, **Pacific.** Günther, Cat., VIII, 100, Zanzibar, Java, Mauritius, Fiji, Seychelles.
? *Murænophis kauy* Lacépède, Hist. Nat. Poiss., V, 646, pl. VII, fig. 2, 1803; no locality.
Thyrsoidea chlorostigma Kaup, Apodes, 89, 1854, **Seychelles.**
Gymnothorax chlorostigma Bleeker, Atlas, 97, tab. XXXIV, fig. 2, East Indies.

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[a] This species, *Enchelynassa canina*, is said to be black, with very long needle-like teeth, and tubular nostrils. The type was only 7.5 inches long, and from the description is probably the young of *Enchelynassa bleekeri*.

Of this strongly marked species, known by its many small yellow spots, black gill-opening and white-tipped tail, we have one large specimen from Apia. Color in life bright brown, with everywhere stellate spots of yellowish white, the spots round and much smaller than eye, smaller on the head and slightly larger and much farther apart on tail; belly, chin, snout, and throat spotted like the body; fins dusky-edged, spotted; tail broadly tipped with white; gill-opening black.

178. **Gymnothorax xanthostomus** Snyder. Hawaii.

179. **Gymnothorax leucostictus** Jenkins. Hawaii.

180. **Gymnothorax goldsboroughi** Jordan & Evermann. Hawaii.

181. **Gymnothorax nuttingi** Snyder. Hawaii.

182. **Gymnothorax eurostus** (Abbott). Hawaii.

183. **Gymnothorax thyrsoideus** (Richardson). Samoa; Tonga; Guam; Faté and Tubuai (Seale); East Indies.

Muræna thyrsoidea Richardson, Voyage Sulphur, 111, 1845, not fig., **China.** Günther, Cat., VIII, 113, China, Pinang. Steindachner, Sitz. Ak. Wiss. Wien 1900, 514, French Pass.
Muræna griseobadia Richardson, Voyage Erebus and Terror, 89, **Tonga.**
Muræna prosopeion Bleeker, Nat. Tijd. Ned. Ind., IV, 300, **East Indies.**
Gymnothorax prosopeion, Bleeker, Atlas, Murænidæ, 88, tab. XXXIX, fig. 3.
Muræna tile, Seale, Bishop Museum, 1901, 62, Guam; not of Hamilton.

This widely diffused species may be known by its pale color and small whitish spots, with the anterior part of the head abruptly blackish. It is probably the species called *Muræna tile* by Seale.

A small specimen from Pago Pago. Color in life light gray, mottled with light purple, leaving the ground-color as pale spots; head distinctly dark purplish or blackish; iris white; gill-opening and angle of mouth pale; dorsal colored like the body, with a broad pale edge; anal pale.

184. **Gymnothorax pictus** (Ahl). *Pusi gatala.* Hawaii; Samoa; New Guinea; Tahiti; Rarotonga; Mangareva; Makatea; Shortland I. (Seale); East Indies.

This species, readily known by its pale color and purplish specklings which gradually gather together with age to form dark spots, is very common throughout the South Seas. We have about 10 specimens of various sizes from Samoa, the largest representing the form called *Gymnothorax sidereus*, which is the adult. *Gymnothorax litus*, a closely allied form, seems to us a distinct species.

Color in life of a specimen from Apia, light gray, very finely dotted and marbled with purplish gray, which is purplish brown in larger examples; adult with numerous irregular diffuse transverse bars made up of dark spots, streaks and reticulations, these being a little denser in the bars; these bars composed of three lengthwise series of denser areas, which gradually with age form series of dark spots, the uppermost on the dorsal; top of head and snout densely speckled like the body; chin and throat with scattered purplish specks, which disappear on the belly, which is white; angle of mouth and gill-opening uncolored; anal speckled like the body, the edge less spotted.

In the young there are neither spots nor bars, but the ground-color is covered with reticulations of different degrees of intensity, the fish always pale purplish with white belly.

185. **Gymnothorax litus** (Richardson). Tahiti; Marquesas Is.; Samoa; East Indies.

Muræna lita Richardson, Voyage Erebus and Terror, 81, 1846, **Moluccas.**
Gymnothorax pictus Bleeker, Atlas, Murænidæ in part, tab. XXIX, fig. 1, but not description.
Muræna nigrolineata Kaup, Apodes, 66, 1854, **Marquesas Is.**
Muræna chrysops Kaup, Apodes, 70, 1854, **Tahiti.**

Of this species we have several specimens from Apia. It is close to *Gymnothorax pictus*, but is apparently distinct, having the color darker, and the lower jaw and throat profusely marked with blackish lines. This region is faintly speckled in *G. pictus*. *G. chrysops* seems to be the same species and *G. nigrolineatus* also may be the same.

Color in life of a specimen from Apia, ground-color yellowish olive, darker above, thickly covered with reticulations and specklings of dark purplish brown, darker than in *G. pictus;* some trace of irregular dark reticulated cross-streaks on tail; fins colored like the body, as are head, throat and belly; lower jaw and throat closely spotted; no black at angle of mouth nor on gill-opening; no pale edges to fins.

186. Gymnothorax tænioides (Günther). Samoa.

Muræna tænioides Günther, Proc. Zool. Soc. 1871, 674, **Savaii (Samoa).**

This species is quite unlike any taken by us in Samoa. We have not seen it.

187. Gymnothorax favagineus Bloch & Schneider. Samoa; Faté, New Hebrides (Seale); East Indies.

Gymnothorax favagineus Bloch & Schneider, Syst. Ichth., 525, taf. 105, **Tranquebar.**
Muræna tessellata Richardson, Ichth. Sulphur, 109, pl. 55, figs. 5–8, 1845. Günther, Cat., VIII, 106, **Zanzibar, East Indies.**
Gymnothorax tessellatus Bleeker, Atlas, 93, tab. XXVII, fig. 3; pl. 28, fig. 1.
Muræna python Kaup, Apodes, 68, fig. 53, **Africa.**

Of this East Indian species we have one small example from Samoa. It much resembles Bleeker's figure of *Gymnothorax tessellatus.* Apparently *G. isingteena*, with the spots separated by broad interspaces of the ground color, is a different species.

Color in life of a specimen from Pago Pago, pale yellowish olive, with four rows of blackish olive spots along the side, larger than eye on body, smaller on head, very regular, a similar row on dorsal and anal; belly also spotted; the ground color reduced to a broad net-work around the spots.

188. Gymnothorax polyophthalmus (Bleeker). Samoa; Caroline Is.; East Indies.

Muræna polyophthalmus Bleeker, Act. Soc. Ned. Ind., III, Celebes, x, 15, **Celebes.**

Of this species, hitherto known from one small example, we have two examples equally small, from Apia, and a larger one, 8.75 inches long, from Kusai Island, Caroline Group. All of them resemble Bleeker's figure very closely. The body is covered with many black spots on a light ground, the largest of them being rings with a yellow center.

Color in spirits, light olive, almost white below, with about three rows of dark olive spots as large as eye, each spot being ring-like with a yellowish center of the ground-color; besides these many small dark spots and specks; a row of ring-like spots on dorsal with many smaller specks; a row of blackish spots along base of anal; posterior half of dorsal and whole of anal with a broad unspotted edge; spots anteriorly very small; scattering spots on chin and belly; gill-opening pale; no spot at angle of mouth.

189. Gymnothorax stellatus (Lacépède). *Pusi pulepule.* Samoa; New Britain; East Indies.

Murænophis stellatus Lacépède, Hist. Nat. Poiss., v, pp. 622, 629, 644, 1803, **New Britain.**
Muræna fimbriata Bennett, Proc. Comm. Zool. Soc., 1, 1831, 168. Günther, Cat., VIII, 108, Borneo, **Amboina,** Port Essington.
Muræna bullata Richardson, Voy. Erebus and Terror, 86, 1846, **Borneo.**
Muræna isingleenoides Bleeker, Verh. Bat. Gen., XXV, Mur., 48, **East Indies.**
Gymnothorax isingleenoides Bleeker, Atlas, Murænidæ, 91, tab. XXXV, fig. 1, East Indies.

Of this strongly marked species we have eight specimens from Apia. Lacépède's *stellatus*, with two rows of black spots, is probably the same as the *fimbriatus* of Bennett.

Color in life of one specimen, body pale reddish olive with many purplish black spots, irregular in form, about as large as eye; the oblong spots longer, the spots all narrower than the interspaces; spots arranged in about 3 rows, with a row also on dorsal fin and the lower row extending on anal; belly pale, unspotted; dorsal and anal with a yellowish margin, broader on anal, which is mostly pale; head with much smaller spots, sparsely placed; folds on neck dark, conspicuous; gill-opening pale; angle of mouth with a small black spot, a whitish spot before it on the lower jaw only; chin and snout dark.

190. Gymnothorax buroensis (Bleeker). Caroline Is.; Samoa; East Indies.

Muræna buroensis Bleeker, Nat. Tijds. Ned. Ind., VIII, 79, **Buro.**
Gymnothorax buroensis, Bleeker, Atlas, Murænidæ, 90, tab. XL, fig. 1, East Indies.

Of this species we have 10 specimens from Samoa and three from the island of Kusai, in the Carolines, collection of Mr. A. P. Lundin. The species is always very dark, with darker spots and markings, which vary considerably with age and shade of color. The tip of the tail is always white. We identify our specimens with *buroensis* with a little doubt, but there is no other species with which we can place them.

Color in life of a specimen from Apia, dark brown, a little paler below; dorsal fin high, with very obscure black bars, and behind edged with light orange; the body also faintly barred with darker. This coloration was seen in three young examples obtained from a cracked coral head.

Color in spirits (adult specimens) very dark purplish brown, with longitudinal rows of small, diffuse, irregular black spots, smaller than eye, arranged in about four irregular rows; these spots rather larger on the tail, smaller towards the head, which is not spotted; top of head and snout dark; angle of mouth not colored; gill-opening not colored; fins colored like the body, the caudal with a narrow pale edge; throat pale, unspotted; belly darker and spotted posteriorly.

191. Gymnothorax mucifer Snyder. Honolulu.

Gymnothorax mucifer Snyder, Bull. U. S. Fish Comm., XXII, 1903 (1904), 519, pl. 5, fig. 9, **Honolulu.**

This species is known from a single example from Hawaii. It strongly resembles *Gymnothorax buroensis*, but in the latter the upper teeth are in two rows.

192. Gymnothorax laysanus (Steindachner). Hawaii; Laysan.

Muræna laysana Steindachner, Denks. Ak. Wiss. Wien, XVI, June 27, 1900, 177, **Laysan.**
Gymnothorax laysanus, Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (1903), 425, Honolulu. Snyder, Bull. U. S. Fish Comm., XXII, 1902 (1904), 518, Honolulu, Hilo.
Lycodontis parvibranchialis Fowler, Proc. Ac. Nat. Sci. Phila. 1900, 404, **Hawaii.**

This species is occasionally taken about the Hawaiian Islands. Dr. Steindachner's second figure representing a species finely speckled with white only may represent some other species. Fowler's *parvibranchialis* with white spots in about four rows seems to be identical with our smaller specimens.

193. Gymnothorax polyuranodon (Bleeker). New Guinea (Bleeker); East Indies.

194. Gymnothorax hilonis Jordan & Evermann. Hawaii.

195. Gymnothorax tenebrosus (Richardson). Tahiti (Seale).

Muræna tenebrosa Richardson, Voy. Erebus and Terror, 84, 1846; locality unknown, probably **Tahiti.**

196. Gymnothorax variegatus (Quoy & Gaimard). Guam.

197. Gymnothorax chalazius Waite. Tubuai; Austral Is. (Seale); Australia.

Gymnothorax chalazius Waite, Rec. Austr. Mus., V, 145, 1904, **Lord Howe I.**

An ally of *Gymnothorax laysanus*, recently taken by Mr. Seale at Tubuai.

198. Gymnothorax javanicus (Bleeker). *Pusi maoa'e.* Samoa; East Indies.

Muræna platbernon Richardson, Voy. Erebus and Terror, 84, 1846, **Darnley I.**; not of Quoy & Gaimard.
Muræna javanica Bleeker, Nat. Tijds. Ned. Ind., XIX, 241, **Java.**
Gymnothorax javanicus, Bleeker, Atlas, Murænidæ, 95, tab. XXXV, fig. 2.

Of this species we have five examples from Samoa from 1¼ to 4 feet in length. It is one of the largest eels of the South Seas, and the coloration is the same at all ages. The species is well separated from *G. batuensis*, with which and with several other species Dr. Günther has confounded it under the name *G. flavomarginatus*. *Murænophis griseus* Lacépède seems to be *G. pictus*. *Muræna geometrica*=*Muræna bilineata* Rüppell is a species of *Echidna*.

Color in life of a very large specimen from Apia, brownish with blacker spots, larger behind; a large black spot around gill-opening. Another specimen from Apia in life was reddish brown with jet black spots and blotches, irregular in size but much larger than eye; about three rows on body, reducing ground-color to broad reticulations; about 40 to 50 spots in a row, those of the upper row extending on the dorsal, the spots rather larger than those in the second row; those of the third row still smaller; belly paler, with smaller black spots; head similar, the spots small, much smaller than eye; angle of mouth black; gill-opening in a large black spot; wrinkles on head dark; fins spotted and colored like the body; tip of tail with a pale edge; obscure pale edging to fins behind.

199. Gymnothorax flavomarginatus (Rüppell). *Pusi gatala* (spotted moray). Samoa; Hawaii; New Guinea; Norfolk I.; East Indies.

Muræna flavomarginata Rüppell, Atlas, 119, tab. XXX, fig. 3, 1828, **Red Sea.** Günther, Cat., VIII, 119, Zanzibar, Seychelles, Batu, Norfolk Island.
Gymnothorax flavomarginatus, Bleeker, Atlas, Murænidæ, 95, tab. XXXII, fig. 2, tab. XXXIV, fig. 3, East Indies.
Muræna batuensis Bleeker, Nat. Tijds. Ned. Ind., XII, 241, **Batu.**

This dull-colored moray is, with *Gymnothorax undulatus*, the most common species at Samoa, and it is occasionally taken at Hawaii. It is readily known by the small dusky spots which cover the whole body, obscuring the pale ground color. The gill-opening is black, and there is a mere trace of a yellow edge to the vertical fins posteriorly, but hardly a yellow margin. The fore part of the head is black. This is apparently the *Muræna flavomarginata* of Rüppell, as supposed by Bleeker.

Color in life of a specimen from Apia, yellow-olive, darker above, with some yellow spots; body and fins with black spots; fins narrowly edged with yellow; front of head black.

Color of same specimen in alcohol, dusky olive, paler below; everywhere with confluent marblings or spots of purplish brown, the olive ground-color appearing as small, irregular, yellow spots or vague streaks; head a little darker; snout and tip of chin black; gill-opening in a conspicuous black spot; angle of mouth black; tip of caudal narrowly edged with yellowish white, the color extending as a very narrow edge on vertical fins; dorsal nearly black, mottled like the body; anal similar.

200. **Gymnothorax thalassopterus** Jenki

Gymnothorax thalassopterus Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (1903), 427, pl. II, **Honolulu**; not cotypes.

This species is known from one specimen from Honolulu. In this type, as shown in Jenkins' figure, the dark spots on the body are almost all separate, not confluent as in *G. flavomarginatus*. In all other regards the two forms seem to agree, and *G. thalassopterus* is probably only a variant individual of the latter species. The smaller cotypes from Honolulu mentioned by Dr. Jenkins are the ordinary *flavomarginatus*, the dark spots everywhere confluent as usual.

201. **Gymnothorax talofa** Jordan & Starks, new species. Samoa.

Head 7 in entire length; depth 2.33 in head; snout rather sharp, 5 in head; eye 1.80 in snout; length of mouth 1.50 in head; gill-opening smaller than pupil; lower jaw strongly hooked upward toward its tip; in the upper jaw an irregular broken series of sharp canines on each side, slightly hooked backward; posteriorly an outer series of much more regular, closer-set, and smaller series somewhat directed backward; anteriorly and medially two vertical vomerine teeth longer and sharper than the others. On the lower jaw a series of teeth similar to the outer series of upper jaw, while anteriorly are 4 or 5 sharp canines irregular in length; trunk 1.33 in caudal.

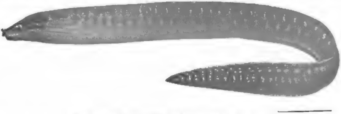

FIG. 7.—*Gymnothorax talofa* Jordan & Starks, new species. Type.

Color in alcohol dark reddish brown, with whitish streaks and blotches arranged in one or two rows with a vague third row below, the ground-color forming dark cross-shades between the whitish streaks. The white markings are in fact short vertical streaks, which on the tail become narrow white wavy cross-bands, relatively conspicuous. Head and anterior part of trunk with a row of diffuse dark blotches on the cross-shades, these distinct near head, where the first one is a long wedge on the temporal region, but fading behind; angle of mouth black; a white streak from snout to vent along the median line; gill-opening pale; fins colored like body; caudal with a narrow yellowish edge; belly and throat plain brown.

Two specimens, from Apia. The type, no. 51713, U. S. National Museum, is 10 inches in length. *Talofa* is the common Samoan salutation, equivalent to the Hawaiian *aloha*.

202. **Gymnothorax detactus** Bryan & Herre. Marcus I.; Samoa; Nukahiva (Seale).

Gymnothorax detactus Bryan & Herre, Bishop Museum, II, 1903, 126, **Marcus I.**

Two specimens from Apia seem to be identical with this species, although Bryan and Herre do not mention the markings at the angle of the mouth.

Color in alcohol pale gray, much mottled and spotted with purplish brown, the brown forming vague branching cross-bars or streaks, much anastomosed, covering belly also, these most bar-like behind; throat and chin paler; no pale edge to fins; angle of mouth brown, with a yellow spot before it on each jaw; pores on jaws white; fins colored like the body.

203. **Gymnothorax rhodocephalus** Bleeker. Rarotonga (Seale); East Indies.

(*Gymnothorax formosus* Bleeker.)

204. **Gymnothorax lineatus** (Lesson). Tahiti; Oualan; Samoa; East Indies.

Murænophis lineatus Lesson, Voy. Coquille, 127, pl. 11, fig. 1, 1830, **Oualan**; poor figure.
Muræna flavolus Lesson, Voy. Coquille, 128, pl. 11, fig. 2, 1830, **Oualan**; smaller specimen, with a better figure.
Muræna grisea Bleeker, Verh. Bat. Gen., XXII, Bali, 11, **Bali**; not of Lacépède.
Muræna richardsoni Bleeker, Nat. Tijds., III, 2.6. Bleeker, Atlas, Murænidæ, 100, tab. XLII, fig. 2. Kner, Novara Fische, 385, Tahiti. Günther, Cat., VII. 118, Zanzibar, Amboina, Ceram, East Indies.
? *Muræna ceramensis* Bleeker, Nat. Tijds., III, 297, **Ceram**.
Gymnothorax ceramensis Bleeker, Atlas, Murænidæ, 101, tab. XXXIII, fig. 3.
Muræna scoliodon Bleeker, Verh. Bat. Gen., XXV, Murænidæ, 43, **Sumatra.**
Muræna trucheli Bleeker, Verh. Bat. Gen., XXV, Murænidæ, 45.
Muræna venosa Kaup, Apodes, 68, 1854, **Timor.**
Thyrsoidea multifasciata Kaup, Apodes, 67, 1854, **Moluccas.**
Muræna vermicularis Peters, Wiegmann's Archiv, 1855, 271.
Muræna diplodon Peters, Wiegmann's Archiv, 1855, 271.
Muræna floresiana Bleeker, Nat. Tijds., VI, 334, **Flores.**

We refer three examples of a small moray from Apia to Lesson's *lineatus* and *flavolus*. In this species the dorsal fin is very high, the body brown crossed by irregular darker lines, and there is, as in *G. rhodocephalus* and *G. detactus*, a dark spot between two yellow spots at the angle of the mouth. The individual specimens differ somewhat in color, enough to allow for the discrepancies in the poor figures published by Lesson. The common *Gymnothorax richardsoni* of the East Indies seems to be the same species.

Color in alcohol light reddish brown, darker above, with dark vertical broken streaks or bands, very irregular in form and more or less reticulating; at intervals broadening into dark spots; markings a little more irregular on the tail; belly pale, unspotted or else marked like the body; head unspotted; angle of mouth black, with a white spot before it on both jaws; fins very high, paler than body, the cross-streaks on body extending on dorsal and anal; no white edgings on fins; gill-opening pale.

Close to *G. stellatus*, but with the spots replaced by cross-streaks and reticulations. Also near *G. detactus* but the dorsal much higher, and the markings darker and more band-like. *G. rhodocephalus* is also related, but in that species the cross-streaks behind are pale.

205. **Gymnothorax ercodes** Jenkins. Hawaii.

206. **Gymnothorax steindachneri** Jordan & Evermann. Hawaii; Laysan.

Gymnothorax steindachneri Jordan & Evermann, Bull. U. S. Fish Comm., XXII, 1902 (1903), 166, **Honolulu.**
Muræna flavomarginata var., Steindachner, Denks. Ak. Wiss. Wien, LXX, 1900, 514, pl. VI, fig. 3, **Laysan**; not of Rüppell.

Of this species we have several specimens from Hawaii. It bears little resemblance to *Gymnothorax flavomarginatus*, under which name Dr. Steindachner figures it.

207. **Gymnothorax gracilicauda** Jenkins. Hawaii.

This species, with a long and slender tail, is recognized in the original type only, a small specimen, perhaps the young of *Gymnothorax steindachneri*.

208. **Gymnothorax undulatus** (Lacépède). *Pusi pulepule.* New Guinea; Hawaii; Samoa; Tubuai; Raiatea (Seale); East Indies.

? *Muræna marmorata*[a] Quoy & Gaimard, Voy. Uranie, 247, 1824, **Waigiu, Rawak.**

This species is very abundant throughout the South Seas. We have about 8 examples, large and small, from Apia, and many from Hawaii.

Color in alcohol of a large specimen from Apia, dark brown with pale yellow or yellowish-white reticulated and undulated cross-streaks, very numerous and much narrower than the masses of ground color; many of these streaks formed somewhat like an inverted Y; snout dark; a black spot at angle of mouth; gill-opening not black; markings on head more diffuse; black folds along side of neck; belly yellowish, marbled with brownish; fins colored like body, the anal with a narrow yellowish margin; tip of tail with a narrow pale edge.

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[a] The scanty description of Quoy & Gaimard is insufficient to identify this species. It is said to be reddish yellow with a ring-like arrangement of markings. The teeth are said to serrated. It is probably identical with *Gymnothorax undulatus*, but it might be any other of several species.

209. **Gymnothorax berndti** Snyder. Hawaii.

STROPHIDON McClelland.

210. **Strophidon brummeri** (Bleeker). East Indies.

Recorded by De Vis, Proc. Linn. Soc. N. S. W. 1884, 457, **New Hebrides.**

ECHIDNA Forster.

211. **Echidna nebulosa** (Ahl). *Pusi.* Tahiti; Wahia; Tonga; Borabora; Hawaii; Samoa; New Guinea; Shortland I.; Nukahiva (Seale); East Indies.

This widely diffused species is very common about Samoa, where about 40 specimens were taken. It is relatively scarce about Hawaii.

212. **Echidna zebra** (Shaw). Samoa; Hawaii; East Indies.

This species, of a rich brown color, with narrow golden rings, is common at Samoa, where about 30 specimens were taken. It is rather scarce about Hawaii.

213. **Echidna polyzona** (Richardson). Tahiti; Nukahiva (Seale); East Indies.

214. **Echidna zonophæa** Jordan & Evermann. Hawaii.

This species is close to *Echidna polyzona*, but with the other nominal species from Hawaii it seems to differ in having the ground-color broken by mottlings. It may prove identical with *Echidna zonata.* In *Echidna polyzona*, as figured by Bleeker, the ground-color is plain dark brown as in *Echidna zebra*, covered by rings of clear yellow.

215. **Echidna zonata** Fowler. Hawaii.

Echidna zonata Fowler, Proc. Ac. Nat. Sci. Phila., 1900, 496, **Hawaii.**
Echidna vincta Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (1904), 429, **Hawaii.**
Echidna polyzona Fowler, Proc. Ac. Nat. Sci. Phila., 1900, 496, **Hawaii**; not of Richardson.

Dr. Jenkins found this species rather common at Honolulu. We see no difference between the species called *zonata* and *vincta.*

216. **Echidna psalion** Jenkins. Hawaii.

This species is known from a single example, evidently very close to *E. vincta*, if indeed *vincta* and *zonophæa* and possibly *obscura* and *tritor* be not all color variations of the same species, *Echidna tritor.*

217. **Echidna tritor** Vaillant & Sauvage. Hawaii.

218. **Echidna obscura** Jenkins. Hawaii.

219. **Echidna leihala** Jenkins. *Pusi 'ai'aiuga.* Hawaii.

Numerous specimens taken recently at Hawaii leave little room for doubt as to the identity of the nominal species, *Echidna zonata, vincta, psalion, zonophæa, leihala, obscura* with *Echidna tritor.* The variations in the bands are very great, scarcely any two specimens being alike.

220. **Echidna trossula** Jordan & Starks, new species. Samoa.

Muræna nigra, Seale, Bishop Museum, 1901, 62, Guam; not of Day.

Head 7.5 in entire length; depth 2 in head; snout blunt, 6.5 in head; eye 1.5 in snout; tubes of anterior nostrils scarcely as long as diameter of pupil; cleft of mouth from tip of snout to angle 3.33 in head; teeth slightly movable except those in roof of mouth behind vomerine teeth; teeth in upper jaw in a single row on each side, anteriorly rather blunt and conical, posteriorly sharper and smaller; the one sort giving place to the other abruptly; a median row of two teeth anteriorly similar to those of anterior outer row; behind these and remote from them, extending back in the roof of the mouth to opposite the last teeth of the outer row, a patch of blunt teeth usually in two rows, but sometimes in one, or irregularly in two; teeth in lower jaw anteriorly biserial, posteriorly uniserial, resembling in size and shape the outer series of upper jaw; gill-opening as long as eye; nuchal hump well developed; preanal portion of body equal in length to postanal.

Color dark with irregular dark brown spots, each conforming to the shape of its adjoining spots, thickly placed over a light gray ground, leaving a fine network of the latter everywhere.

Life colors in a specimen from Pago Pago, dark brown, fins and tail paler; surface finely dotted with dark points. A specimen from Apia, with head very short, had iris golden red; body brownish, very finely but sharply dotted with darker brown; no markings.

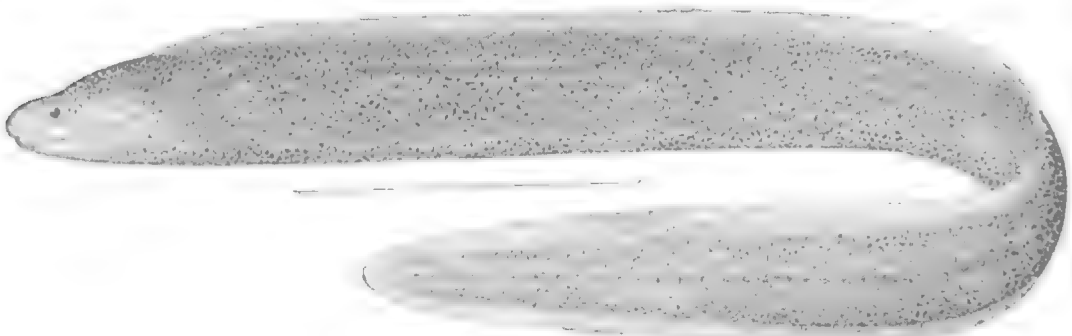

Fig. 8.—*Echidna trossula* Jordan & Starks, new species. Type.

Type no. 51714, U. S. National Museum, a specimen 6.5 inches long, from Apia.

This species, known by the presence of fine black specks all over the body, is rather common about Samoa, where a dozen specimens were taken, at Apia and Pago Pago. A small eel with a small mouth.

221. Echidna uniformis Seale. Guam.

Echidna uniformis Seale, Bishop Museum, 1901, 62, Guam.

222. Echidna delicatula Bleeker. Samoa; East Indies.

Echidna kishinouyei Jordan & Snyder, Proc. U. S. Nat. Mus., 1901, 890, with plate, Riukiu Is.

Of this species, known by the mottled purplish coloration and the anterior insertion of the dorsal, we have 7 examples from Pago Pago. The largest of these is about 18 inches long. This species is well distinguished from *E. amblyodon* of the East Indies, in having the insertion of the dorsal well in front of that of the pectoral.

Life colors of a specimen from Pago Pago, dark olivaceous green, fins paler greenish, body covered all over with brown reticulations around black spots.

223. Echidna amblyodon Bleeker. Marquesas Is. (Seale); East Indies.

ANARCHIAS Jordan & Starks, new genus.

Anarchias Jordan & Starks, new genus of Murænidæ (*A. allardicei*).

This genus contains small morays resembling *Gymnothorax*, but entirely lacking the anal fin; the dorsal is developed as usual.

224. Anarchias allardicei Jordan & Starks, new species. Samoa.

Head 8.5 in length; depth 2.3 to 2.7; snout slightly blunter than in *A. knighti*, 5.5 in head; eye 1.5 in snout; length of mouth 2.7 to 3 in head. Teeth similar to those of *A. knighti* except that there is only a single vomerine tooth; tube of anterior nostril less than half diameter of eye; large pores rather widely separated follow along the edge of mandible and border mouth above; three of them on each side of upper part of snout, the most posterior one at upper edge of eye; trunk 1.2 to 1.7 in tail. No anal fin; no distinct caudal; no pectoral.

Four specimens, two from Apia, two from Pago Pago.

Life colors of a Pago Pago specimen dark clear brown, the dorsal blackish; tip of tail bright yellow Specimen caught in the coral by cracking the large growing heads.

An Apia specimen was brown, lighter beneath; tip of tail bright yellow.

Color in spirits, everywhere a uniform dark reddish brown darker above; tip of caudal and under part of mandible pale.

Type no. 51715, U. S. National Museum, 160 mm. in length, from Pago Pago.

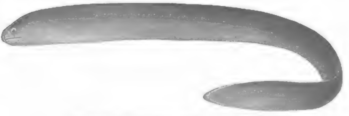

FIG. 9.—*Anarchias allardicei* Jordan & Starks, new species. Type.

225. Anarchias knighti Jordan & Starks, new species. Samoa.

Head 9.5 in full length; depth 2.13 in head; snout short and moderately blunt, 7.25 in head; eye 1.2 to 1.5 in snout; length of mouth, 3 in head. Teeth in two series in the upper jaw, the outer series more close-set, smaller and more regular than the inner, the inner series rather large, sharp, and of unequal length; anteriorly a pair of median vomerine teeth similar to those on the inner row; teeth of mandible in two rows and resembling those of upper jaw; tube of anterior nostril half diameter of eye; gill-opening very small, smaller than pupil. Length of trunk contained 1.17 in tail.

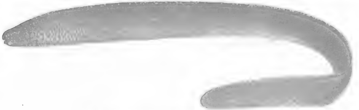

FIG. 10.—*Anarchias knighti* Jordan & Starks, new species. Type.

In spirits a network of dark lines covers the head and body over a ground color of slaty brown. These in the type cover the body everywhere except under the mandible, which is white. In the cotype the underparts are only slightly mottled, leaving them a soiled white.

This species differs from *A. allardicei* particularly in having the body mottled, and in having a slightly longer snout and mouth and a slightly larger eye. It is known from two examples taken at Apia by Prof. Robert Edgar Allardice and Master Knight Starr Jordan. Type, no. 51716 U. S. National Museum, 115 mm. in length, and the cotype, 145 mm., both from Apia.

SCUTICARIA Jordan & Snyder.

226. Scuticaria tigrina (Lesson). *Pusi solomulu.* Hawaii; Samoa; Borabora; Tonga; Johnston I.; Tahiti; Nukahiva (Seale).

This species is occasionally taken at Samoa and at Hawaii. It is common in the East Indies. We have 10 examples from Apia and Pago Pago.

Life colors of an example from Pago Pago, livid pale-pinkish brown with black spots.

UROPTERYGIUS Rüppell.

227. Uropterygius marmoratus (Lacépède). New Britain; Hawaii; Samoa; Oualan; Nukahiva (Seale).

This large eel, known by its finely mottled coloration and the paler color of its vertical fins, is occasionally taken in Samoa, whence we obtained about 10 examples. It is also sometimes taken in Hawaii.

Life colors of a specimen from Apia, dark brown, all freckled with white above and below, the white tending to form reticulations around brown confluent spots.

228. Uropterygius macrocephalus (Bleeker). *Pusi, Sulalulu.* Samoa; East Indies.

Of this species we have about a dozen specimens from Apia, the longest about 8 inches in length. The body in all is mottled, the caudal pale. These may be the young of *Uropterygius marmorata*, as Günther suggests, but it is not likely. We find no tube on the posterior nostrils, and so place it in a different species. It is possible that this species is not distinct from *Uropterygius micropterus* Bleeker, which differs in the shorter head.

Life colors in a specimen from Apia, livid bluish white, with fine brown reticulations.

229. Uropterygius concolor Rüppell. Samoa; Nukahiva (Seale); Red Sea.

Gymnomuræna fusca Peters, Berl. Mon. 1866, 524, **Amboina.**

In this species the color is uniform purplish red without spots, the fins scarcely paler. It agrees fairly with the accounts of *U. concolor*, and still better with that of *G. fusca.*

230. Uropterygius leucurus Snyder. Lanai, Hawaiian Is.

231. Uropterygius xanthopterus (Bleeker). Nukahiva (Seale); East Indies.

Family NOTACANTHIDÆ.

NOTACANTHUS Bloch. (*Gigliolia* Goode & Bean.)

232. Notacanthus moseleyi (Goode & Bean). South Pacific.

Family BELONIDÆ.

BELONE Cuvier.

233. Belone platyura Bennett. *Ise.* Hawaii; Samoa.

Of this species, rather common about Hawaii, one specimen was taken at Apia. It is readily recognized by the presence of gillrakers and by the large caudal keel. Anal 20; dorsal 15; tail very much depressed, flat-keeled; axil dusky.

Life colors, deep green, with blue luster above, abruptly white on sides; luster everywhere clear blue; fins pale; tip of dorsal and upper caudal lobe dusky; anal and ventral somewhat dusky.

TYLOSURUS Cocco.

234. Tylosurus leiuroides (Bleeker). *A'u.* Samoa; New Guinea (Macleay); East Indies.

Four specimens of this species were taken at Apia. Life colors of one of these, gray, side silvery with silvery blue lateral line; jaws bluish edged; luster bluish, no green; fins translucent bluish; dorsal a little purplish on lobe, not black; last dorsal rays low; head deeply sculptured.

235. **Tylosurus coromandelicus** (Van Hasselt). New Britain; East Indies.
(*Belone melanotus* Bleeker.)

236. **Tylosurus urvillei** (Cuvier & Valenciennes). Vanicolo.

237. **Tylosurus cancila** (Hamilton-Buchanan). New Guinea (Macleay); East Indies.

238. **Tylosurus giganteus** (Schlegel). *A'u.* Samoa; Hawaii; Levuka; Oualan; Kandavu; Fiji; New Guinea (Macleay); Tubuai Is. (Seale); East Indies; Japan.

This huge species is rather common about Samoa, as also at Hawaii and throughout the tropical Pacific. We obtained three moderate-sized and a few very large specimens from Samoa. One specimen leaped from the water to seize a charge of dynamite in the air.

ATHLENNES Jordan & Fordice.

239. **Athlennes hians** (Cuvier & Valenciennes). Hawaii; West Indies; Acapulco.

Family EXOCŒTIDÆ.

HEMIRAMPHUS Cuvier.

240. **Hemiramphus pacificus** Steindachner. Hawaii; Samoa.

Of this species about 20 specimens were taken with the seine near the mouth of the harbor of Pago Pago. The fish is not rare about Hawaii.

Life colors, light olive, silvery below; a clear blue line bounding silvery stripe above; all dark parts of body with bright blue luster; base of anal with blue stripe; tip of lower jaw deep orange.

241. **Hemiramphus depauperatus** Lay & Bennett. Hawaii; Marcus I.

242. **Hemiramphus affinis** Günther. *Ise lai.* Samoa; New Hebrides (Seale).

This species is the common *ise* or halfbeak, found everywhere in shallow water along the shore at Samoa. It is distinguished from related species by the insertion of the ventrals nearer base of caudal than gill-opening. We have about 50 specimens. None of our specimens have the head quite as long as indicated in Günther's description. The head with lower jaw is 2.75 to 3 in length to base of caudal.

Life colors of a specimen from Pago Pago, dorsal with blackish-edged blotch; a dusky spot in pectoral axil; lateral line and a lateral streak bright clear green; membranes of lower jaw dusky, with some red. A specimen from Apia had the lower jaw very red below; two blue streaks on each side of body.

243. **Hemiramphus laticeps** Günther. Fiji.

244. **Hemiramphus limbatus** Cuvier & Valenciennes. Guam; East Indies.

245. **Hemiramphus argenteus** Bennett. Open sea, near equator.

246. **Hemiramphus eclancheri** Cuvier & Valenciennes. Marquesas (Cuvier & Valenciennes, Seale).

247. **Hemiramphus quoyi** Cuvier & Valenciennes. New Guinea (Macleay); East Indies.

248. **Hemiramphus gaimardi** Cuvier & Valenciennes. Papua; East Indies.

249. **Hemiramphus commersoni** Cuvier. Fiji (Günther); New Guinea; Shortland I. (Seale); East Indies.

250. **Hemiramphus australiensis** Seale. Tubuai (Seale).

251. **Hemiramphus cantori** Bleeker. New Guinea (Macleay); East Indies.

252. **Hemiramphus acutus** Günther. Rarotonga.
Hemiramphus acutus Günther, Proc. Linn. Soc. N. S. W. 1841, 671, **Rarotonga** (**Cook Is.**).

253. **Hemiramphus melanurus** Cuvier & Valenciennes. Solomon Is. (Seale); East Indies.

EULEPTORHAMPHUS Gill.

254. **Euleptorhamphus longirostris** (Cuvier & Valenciennes). Hawaii; open Pacific; warm seas generally.

ZENARCHOPTERUS Gill.

255. **Zenarchopterus dispar** (Cuvier & Valenciennes). New Guinea (Macleay); East Indies.

256. **Zenarchopterus maculosus** Garman. Fiji.

257. **Zenarchopterus vaisiganis** Jordan & Seale, new species. *Tuoto.*

Head, without lower jaw, 4.30 in length, with lower jaw, 2.30; lower jaw from tip of upper 3.90; eye 3.60 in head; upper jaw slightly broader than long, about equal to eye; interorbital slightly greater than eye; dorsal 12; anal 12; modified with a clasping organ, with a fleshy intromittent organ just anterior to base; scales 2-43-3; snout 3.10.

Body elongate, the depth 1.75 in head, the width 2.75; scales deciduous, the lateral line running very low on body; depth of caudal peduncle equal to interorbital space; width of preorbital in front of eye equal to pupil; opercle and preopercle entire; suborbital with more or less adipose membrane; villiform teeth in jaws, none on vomer, maxillary or tongue; gill-rakers thick, rather blunt, the longest about 2 in pupil, 12 developed on lower limb; base of dorsal fin 1.30 in head, fully one-half being on caudal peduncle, fourth and fifth rays are elongate, being about equal to base of fin; longest ray of anal, which is widened and elongate, forming one of the wings of the claspers, is about equal to length of head; fleshly base of anal equal to eye; ventral small, 2.95 in head, its origin far back at beginning of posterior third of body; pectoral 1.20 in head; intromittent organ very prominent, situated between tip of ventrals and base of anal, its width 2 in length; caudal rounded, 1.20 in head.

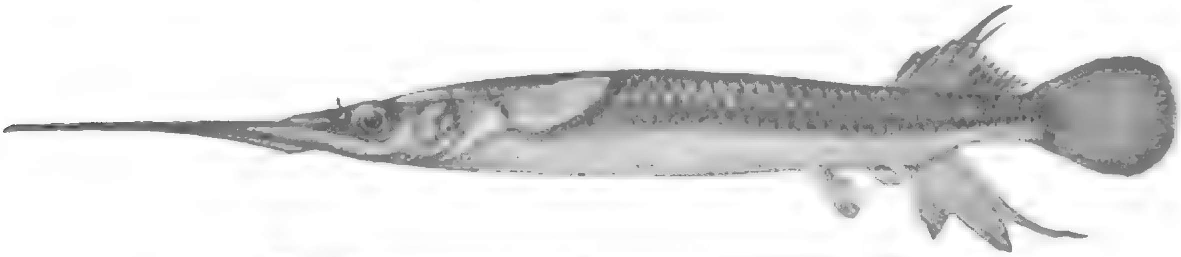

FIG. 11.—*Zenarchopterus vaisiganis* Jordan & Seale, new species. Type.

Color in spirits, silvery below, darker above, with wash of greenish blue, a distinct dark-blue line from opercles to base of caudal; lower jaw deep blue; orbit with rim of blue; anterior of anal with dusky wash; a black spot on anterior dorsal, the fin more or less washed with dusky; caudal with dusky wash; other fins with very slight trace of dusky.

Color in life, pale olivaceous; a silvery streak along side; fins dirty-yellowish olive.

Fourteen specimens from Vaisigano River, at Apia. The type is no. 51718, U. S. National Museum, length 6 inches.

EVOLANTIA Snodgrass & Heller.

258. **Evolantia microptera** (Cuvier & Valenciennes). Hawaii; New Ireland; East Indies; Galapagos Is.

PAREXOCŒTUS Bleeker.

259. **Parexocœtus brachypterus** (Solander). Tahiti; Hawaii; Laysan; West Indies.

260. **Parexocœtus brevipinnis** (Cuvier & Valenciennes). New Ireland.

261. **Parexocœtus rostratus** (Günther). Hawaii.

EXOCŒTUS Linnæus.

262. **Exocœtus volitans** Linnæus. Hawaii; East Indies; Atlantic Ocean.

CYPSILURUS Swainson. *Malolo.*

263. Cypsilurus unicolor (Cuvier & Valenciennes). Vanicolo; sea between Auckland and Samoa; Tasman Sea.

Exocœtus unicolor Cuvier & Valenciennes, Hist. Nat. Poiss., XIX, 97, 1846, **Vanicolo.**
Exonautes unicolor, Jordan, Guide to the Study of Fishes, II, 213, 1905.

Of this species we have 4 examples taken in the sea south of Samoa, and one from the Tasman Sea between Sydney and Auckland. All were obtained by Mr. A. P. Lundin, then navigator of the steamer *Sierra*. The species reaches a length of about 18 inches. On the specimen figured 4 parasitic copepod crustaceans (*Penella*) were attached, and on each of these were attached parasitic barnacles, *Conchoderma virgatum*, looking like a cluster of strange orchids.

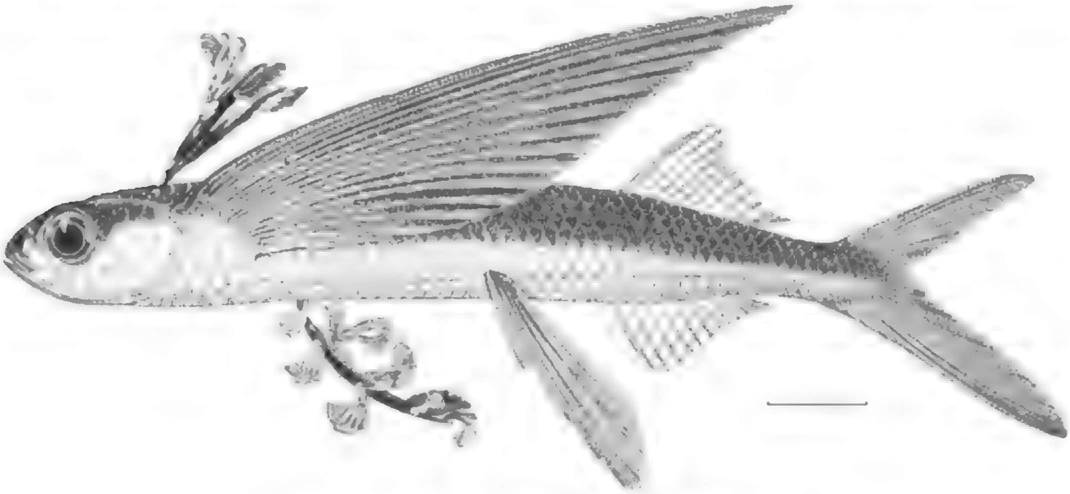

FIG. 12.—*Cypsilurus unicolor* (Cuvier & Valenciennes).

264. Cypsilurus gilberti Snyder. Hawaii.

265. Cypsilurus speculiger (Cuvier & Valenciennes). Tasman Sea, between Auckland and Sydney.

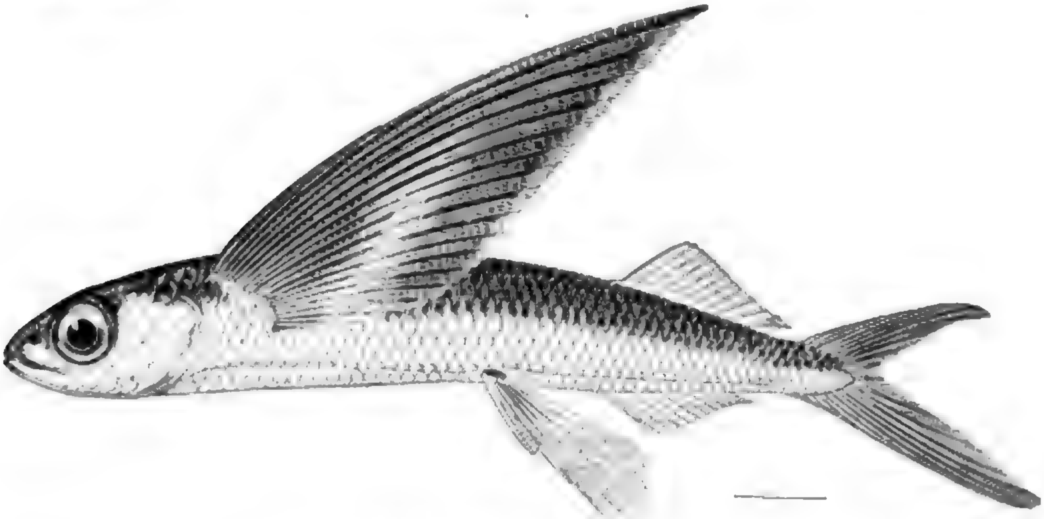

FIG. 13.—*Cypsilurus speculiger* (Cuvier & Valenciennes).

Of this species we have 5 examples taken by Mr. A. P. Lundin, in the Tasman Sea, between Sydney and Auckland. According to Dr. Lutken, this species occurs in the Atlantic also. The Atlantic species, called *Exocœtus rubescens*, *roberti*, and *affinis*, and wrongly called *Exocœtus volitans*, is, however, probably different, having the band on the pectoral less marked.

266. Cypsilurus lamellifer (Kner & Steindachner). Open Pacific.

Exocoetus lamellifer Kner & Steindachner, Sitz. Ak. Wiss. Wien 1867, 384, Pacific.

267. Cypsilurus atrisignis Jenkins. Hawaii; Kusai, or Strong I., Caroline Group.

Of this species, besides Dr. Jenkins's type from Hawaii, we have a second, taken at Kusai, or Strong Island, of the Caroline group, by Mr. A. P. Lundin, then navigator of the missionary vessel *Morning Star*.

268. Cypsilurus pœcilopterus (Cuvier & Valenciennes). New Britain; Tahiti; Caroline Is.; Samoa; East Indies.

Exocœtus spilopterus Günther, Cat., VI, 292, Caroline Is.

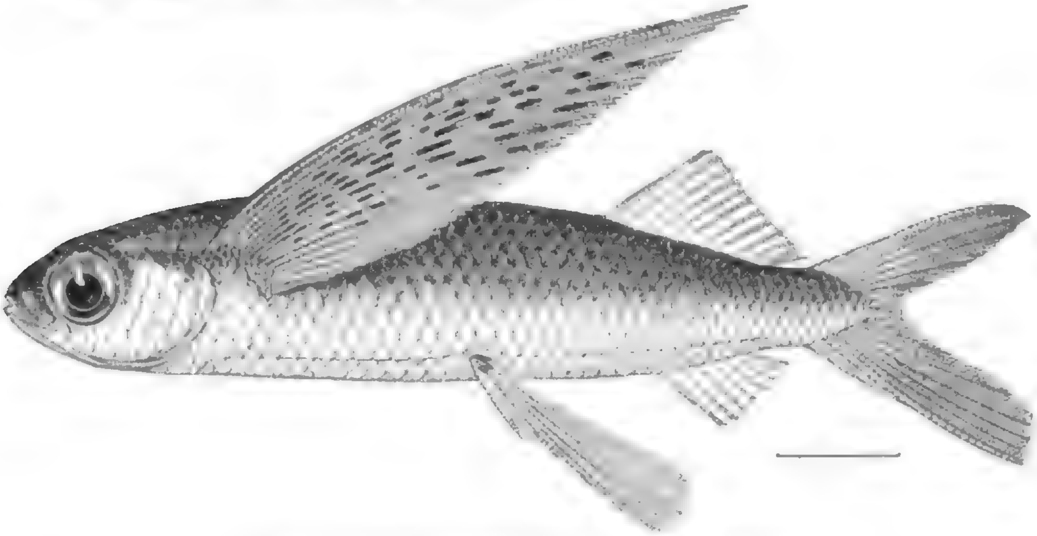

FIG. 14.—*Cypsilurus pœcilopterus* (Cuvier & Valenciennes).

This species is easily recognized by its plump body and spotted pectorals. Its maximum size is smaller than that of *Cypsilurus simus* and *C. quindecimradiatus*, the length being about 9 inches. Life colors of one specimen blue above, pectoral with large spots, ventrals plain, basally dusky, no red on pectoral.

One fine example flew on board the steamer *Kauai* off the western end of Tutuila, in the night.

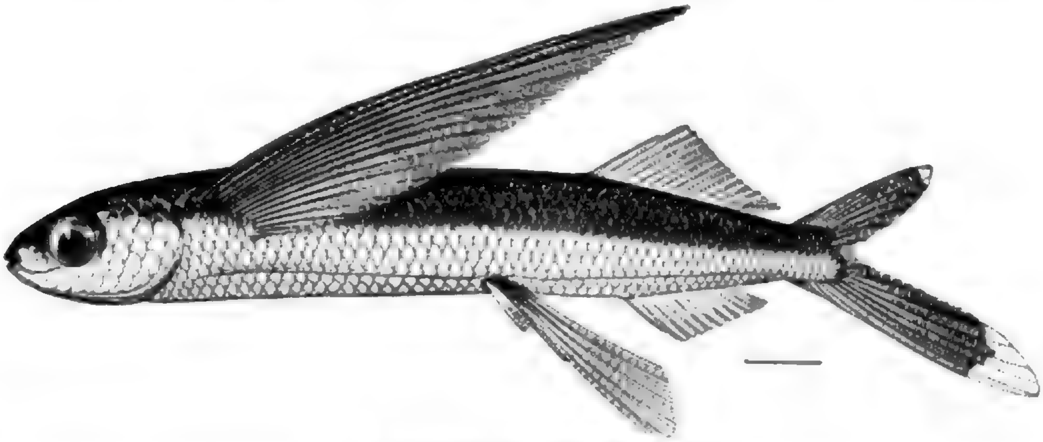

FIG. 15.—*Cypsilurus quindecimradiatus* Fowler.

269. Cypsilurus quindecimradiatus Fowler. Thornton I.; north of Samoa.

Of this well-marked species, distinguished by its long dorsal of 14 or 15 rays, its large size and the absence of pectoral markings, we have two large examples taken by Mr. A. P. Lundin in the sea to the southward of Samoa.

270. Cypsilurus oligolepis Bleeker. Shortland I. (Seale); East Indies.

271. Cypsilurus simus (Cuvier & Valenciennes). Hawaii. Very abundant.

272. Cypsilurus bahiensis (Ranzani). Hawaii, abundant; Atlantic; Panama region.

273. Cypsilurus naresi (Günther). Fiji; New Hebrides.

274. Cypsilurus solandri (Cuvier & Valenciennes). Tahiti; Seychelles.

275. Cypsilurus longibarba (De Vis). New Britain.

Exocœtus longibarba De Vis, Proc. Linn. Soc. N. S. W. 1884, 454, **New Britain**; very young.

276. Cypsilurus katoptron (Bleeker). Seas south of Samoa; Australia; East Indies.

Exocoetus robustus Günther, Cat., VI, 289, 1866, **Australia.**

A specimen of this species agreeing well with Bleeker's figure was taken by Mr. Lundin, then mate of the steamship *Sierra*, in the open sea south of Samoa. The species has black, white-banded pectorals, much as in *Cypsilurus speculiger*, but the dorsal rays are more numerous (14).

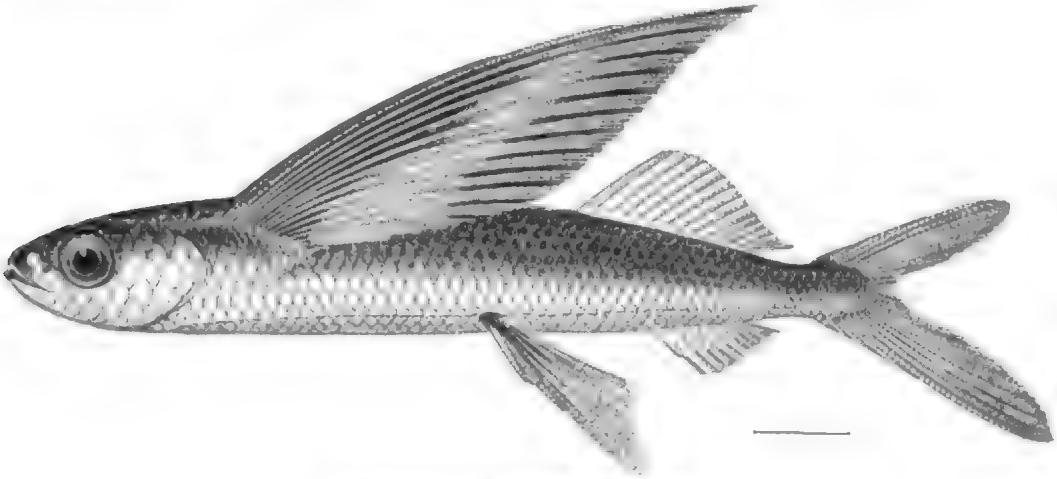

FIG. 16.—*Cypsilurus katoptron* (Bleeker).

277. Cypsilurus arcticeps (Günther). New Guinea (Macleay); China.

Family AULOSTOMIDÆ.

AULOSTOMUS Cuvier.

278. Aulostomus valentini (Bleeker). *Taotito.* Hawaii; Samoa; Tahita; Paumotu Is.; Johnston I.; Aneiteum; East Indies; Japan.

This common East Indian species is occasionally taken in Samoa as in Hawaii. We have one example from Apia.

Family FISTULARIIDÆ.

FISTULARIA Linnæus.

279. Fistularia petimba Lacépède. Fiji; Guam; Hawaii; Samoa; New Guinea; New Britain; Necker I.; Mangareva; New Hebrides; Solomon Is.; Makatea; Rarotonga; Raiatea; East Indies.

This species is common throughout the South Seas. We have a few examples from the shores at Samoa.

280. Fistularia serrata Cuvier. Hawaii; New Guinea; East Indies; Japan.

Family MACRORHAMPHOSIDÆ.

MACRORHAMPHOSUS Lacépède.

281. Macrorhamphosus brevispinis (Kner & Steindachner). **Samoa.**

This species, recorded from Samoa, was not seen by us.

282. Macrorhamphosus finschi (Hilgendorf). New Britain.

Centriscus finschi Hilgendorf, Nat. Freunde, 1884, 52, **New Britain.**

283. Macrorhamphosus hawaiiensis Gilbert. Hawaii.

Family CENTRISCIDÆ.

CENTRISCUS Linnæus.

284. Centriscus komis (Macleay). Palau Is.

Amphisile komis Macleay, Proc. Linn. Soc. N. S. W. III, 1878, 166, **Komis (Palau Is.).**

ÆOLISCUS Jordan & Starks.

285. Æoliscus strigatus (Günther). New Guinea (Macleay); East Indies.

Family SOLENOSTOMIDÆ.

SOLENOSTOMUS Lacépède.

286. Solenostomus cyanopterus Bleeker. Hawaii; New Guinea; East Indies.

Family SYNGNATHIDÆ.

CORYTHROICHTHYS Kaup.

287. Corythroichthys waitei Jordan & Seale, new species. Samoa.

Rings 17 - 35; dorsal 29 or 30, situated on the first 6 caudal rings; snout slender, as viewed from above its edges parallel to the eyes, where the head is abruptly much widened; length of snout 1.2 in head; eyes large, produced above profile, 4.5 in head; a sharp semiconnected ridge extending from behind eyes to just behind pectoral base, three lobed, the first lobe on occiput, the other two on body plates; a sharp ridge extending back from supraorbital crest across parietal region; top of snout with a thin, low ridge; superior thoracic ridge not continuous with superior caudal ridge, but the former extending above the beginning of the latter for 3 or 4 rings; trunk contained 1.5 in caudal portion of the body; color very light, made slightly dusky by a network of fine lines along the sides, these interrupted by diffused light cross-bars on every fifth ring, just anterior to which the network of dark lines is more conspicuous and extends across the back; dark lines irregularly connected with each other, extending more or less horizontally back from the eye. In life snout rose-red, head with black stripe; general color pale yellowish; caudal bright rose-red, its upper and lower margins pale.

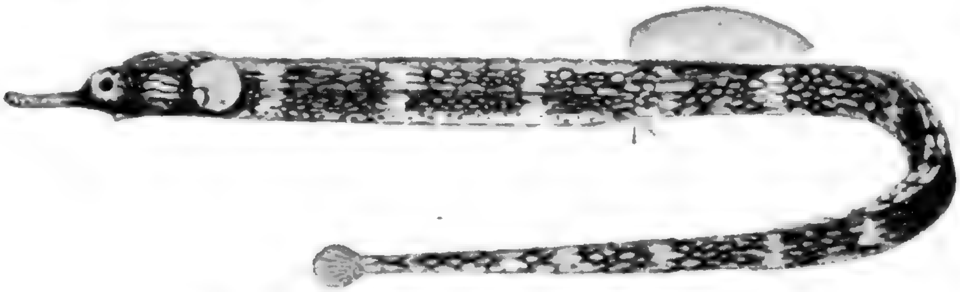

FIG. 17.—*Corythroichthys waitei* Jordan & Seale, new species. Type.

The type is no. 51723, U. S. National Museum, 34 inches in length. This species is named for Mr. Edgar R. Waite, the accomplished curator of the Australian Museum, now of the Canterbury Museum of Christchurch, New Zealand.

288. Corythroichthys sealei Jordan & Starks, new species. Samoa.

Head 7.50; snout equal to distance from middle of eye to posterior margin of opercle, the snout narrow, being scarcely one-half of eye; forehead rather abrupt; rings 16 + 32; dorsal 32 high, the rays being equal to or greater than depth of fish, the base of the fin not elevated; no crest on head or snout; only a trace of a single raised line across opercle; rings of body with six faces, those of the tail with four; distance in front of anal fin 1.75 in posterior part of body; depth 2.75 in head, slightly greater than the width; the egg sac in the male occupies the ventral portion of the sixteenth to twenty-eighth ring; length of dorsal slightly less than width of eye; caudal pin-shaped, 3 in head, anal minute, directly below third ray of dorsal.

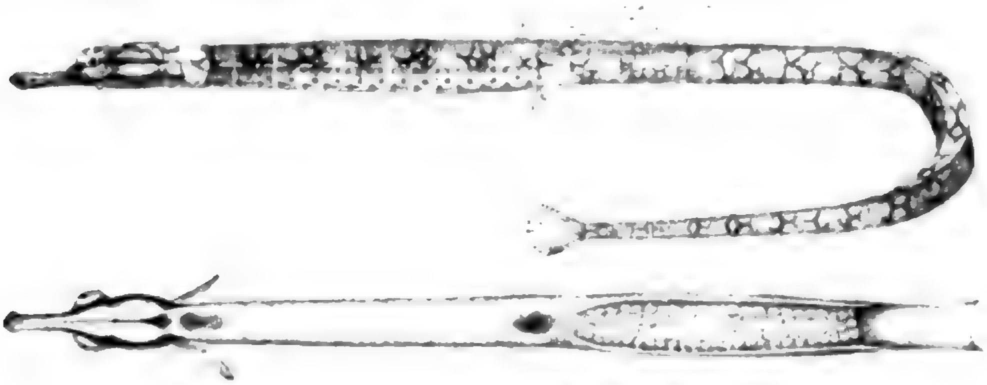

FIG. 18.—*Corythroichthys sealei* Jordan & Starks, new species. Type.

Color in life light gray spotted with reddish brown and lighter gray; snout and caudal whitish; head barred below. Color in spirits whitish, each ring with a branched greenish spangle on side and top, under surface white; two distinct greenish lines along side of head across opercle to base of pectoral, the lower one of these lines extending slightly out on the snout; top of head marked into a number (10) of irregular squares by narrow dark lines; four rings of minute dots around snout; a dark elongate black area on throat, more or less separated from a black ventral spot on first body ring; three rows of small round dots on side of body below the branched greenish spots; dorsal fin with scattered dots.

Three specimens from Apia, the type no. 51722, U. S. National Museum, 3.25 inches long.

289. Corythroichthys mataafæ Jordan & Seale, new species.

Head 11.75; snout 3 in head, narrow, width about 2 in eye; eye 3.75 in head; interorbital very narrow, less than one-half width of eye; rings 15+34, the minute anal fin being on the 15th ring, in the male the egg sac occupying the ventral surface of rings 15 to 26; body seven-sided, the tail but four; dorsal 21, its base not elevated; opercle without a bony ridge extending across it but with numerous radiating rows of pits, the widest point of opercle with a short dermal flap; medial line of snout with a distinct crest with six teeth, the height of crest being slightly less than width of pupil on anterior half of snout, the crest not toothed; no interorbital crest, a short, fringed, dermal tentacle over each eye, its length less than width of interorbital; a single fringed tentacle on middle of nuchal region; a pair of short tentacles just below and a little posterior to eye, another pair below middle of snout; a rim-like projection over upper margin of opercle; snout rather pug-like in shape; pectoral less in length than width of opercle; caudal short, about equal to eye; anal minute.

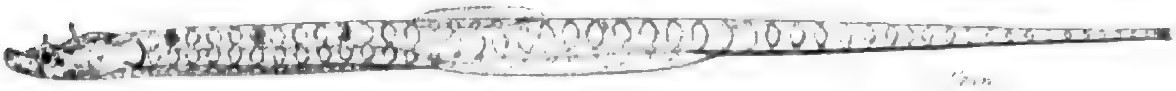

FIG. 19.—*Corythroichthys mataafæ* Jordan & Seale, new species. Type.

Color whitish, each ring on each of its faces with an oval, brown-rimmed spot of silvery; under surface of tail whitish; snout with 2 rings of dusky; about 5 dusky cross lines under throat; about 5 radiating dusky lines in eye and over head.

One specimen, the type, no. 51724, U. S. National Museum, 4.20 inches long, from the coral reefs off Mulinu'u, the residence of Mataafa, chief of Upolu, a distinguished and able statesman, once king of Samoa.

290. Corythroichthys trachypoma (Günther). Thursday I.; Prince of Wales I.

Syngnathus trachypoma Günther, Zool. Alert, 1884, 30.

TRACHYRHAMPHUS Kaup.

291. Trachyrhamphus sp. Marquesas Is.

A specimen badly mutilated and therefore not in fit condition for description, was taken by Mr. Seale at Nukahiva in the Marquesas Islands. It represents probably an undescribed species.

MICROPHIS Kaup.

292. Microphis brachyurus (Bleeker). *Taotao.* Tahiti; Samoa; Aneiteum; East Indies.

About a dozen examples were taken in the Vaisigano River and in other streams about Apia. All the species of this genus in Samoa are confined strictly to fresh waters.

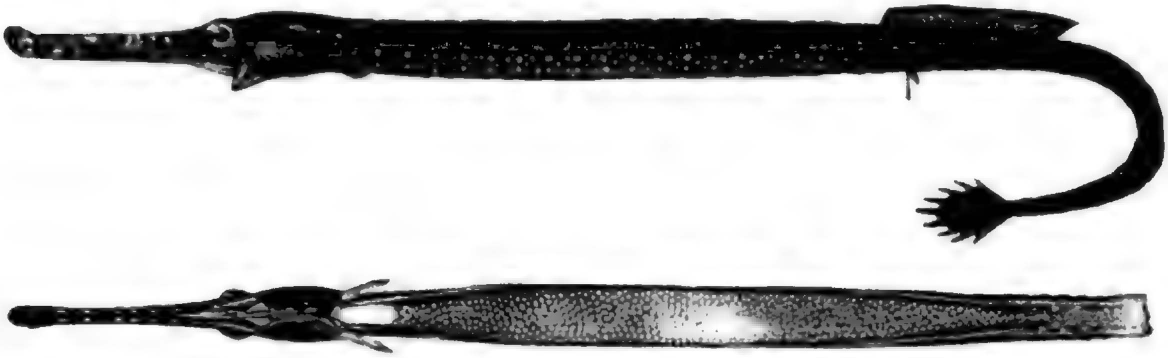

FIG. 20.—*Microphis brachyurus* (Bleeker).

Life colors of one specimen from Apia, light olive, darker on back; a bright red stripe along side from below pectoral backward to middle of trunk; head darker olive, barred with paler olive; caudal dusky olive. Another specimen was dark, speckled with whitish, a vertical orange dash behind opercle the only bright color, and seen in males only.

293. Microphis pleurotænia (Günther). Hawaii.

294. Microphis sculptus (Günther). Fiji.

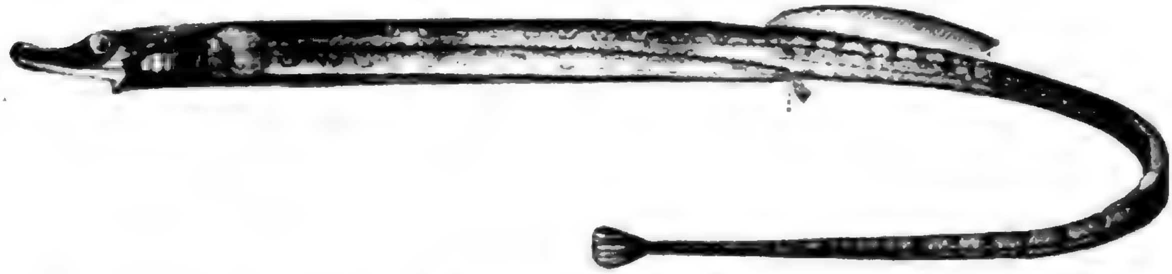

FIG. 21.—*Microphis caudatus* Peters.

295. Microphis caudatus Peters. Samar; Java.

Microphis caudatus Peters, Berl. Mon. 1868, 276, **Samar** (in fresh water), Java.
Doryichthys caudatus Günther, Cat., VIII, 182, Java.

Six specimens of this species were taken in the Gasegase River at Vaimosa, near Apia.

296. Microphis torrentius Jordan & Seale, new species. Samoa.

Head 9.30 to base of caudal, 4.10 in distance anterior to anal; snout 2.20 in head; width of snout 2 in its length; eye about equal to width of snout; interorbital narrow, 2 in eye; dorsal 32; anal 3; rings 16 + 33, no spines; the rings of posterior half square; abdominal rings wider, containing the egg sac; a single unbranched stay across opercle; a low medium ridge on snout and 2 in interorbital; slope of forehead not abrupt; length of pectoral equal to opercle; caudal equal to snout; insertion of the minute anal almost a third nearer tip of snout than tip of caudal; anterior base of dorsal directly over anal.

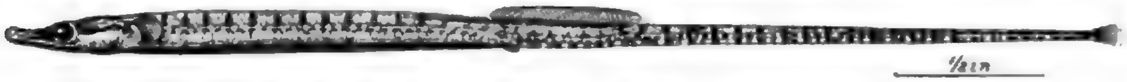

FIG. 22.—*Microphis torrentius* Jordan & Seale, new species. Type.

Color in spirits, greenish with a slightly darker band on each ring; a distinct black line along side of snout through eye, across opercle to base of pectoral; anal with four narrow cross-bands of white.

Three specimens, taken high up in the Vaivase River, near Vailele, to the eastward of Apia, in a swift brook running through pasture land. The type is no. 51725, U. S. National Museum, from near Apia, length 3.25 inches.

GASTEROTOKEUS Heckel.

297. Gasterotokeus biaculeatus (Bloch). Samoa; Papua; East Indies.

Five specimens were taken at Apia and Pago Pago. They were caught in the seine on shallow shores inside the reefs.

Life colors of a specimen from Pago Pago, clear olive brown, finely mottled above; six round jet black spots like ink-dots on lower part of side of body; lower side of head sulphur-yellow, mottled with brown; faint brown bars at tip of tail, which is red; belly yellowish brown, with brown cross-streaks.

ICHTHYOCAMPUS Kaup.

298. Ichthyocampus erythræus Gilbert. Deep seas of Hawaii.

299. Ichthyocampus papuensis Sauvage. New Guinea (Sauvage, Bull. Sci. and Philom. 1880, 228).

HIPPOCAMPUS Rafinesque.

300. Hippocampus fisheri, Jordan & Evermann. Hawaii.

301. Hippocampus hilonis Jordan & Evermann. Hilo, Hawaii.

302. Hippocampus kuda Bleeker. New Guinea (Macleay, as *H. guttulatus*); East Indies.

Family PEGASIDÆ.

PEGASUS[a] Linnæus, 1758 (*volitans*).

Cataphractus Gronow, 1763 (*draco*=*volitans*).
Eurypegasus Bleeker, 1864 (*draco*=*volitans*).
Zalises Jordan & Snyder (*umitengu*, near *draco*).

303. Pegasus volitans Linnæus. New Britain (Peters, Berl. Mon. 1876, 843); East Indies.

304. Pegasus papilio Gilbert. Deep seas of Hawaii.

PARAPEGASUS Duméril.

305. Parapegasus natans (Linnæus). New Guinea; Australia; China.

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[a] The genus *Pegasus* was based, by Linnæus in 1758, on a single species, *Pegasus volitans*. In 1763 the name *Cataphractus* of Gronow was based on the same species, which in 1766 Linnæus renamed *Pegasus draconis*. The same genus was called *Eurypegasus* by Bleeker in 1864 and *Zalises* by Jordan & Snyder in 1902.

Family ATHERINIDÆ.

ATHERINA Linnæus.

306. Atherina lacunosa Forster. New Caledonia; New Hebrides; Fiji (Günther); Solomon Is. and New Hebrides (Seale); East Indies.

(*Atherina pinguis* Lacépède.)

307. Atherina forskali Ruppell. New Guinea (Macleay); East Indies.

308. Atherina endrachtensis Cuvier & Valenciennes. New Guinea; Australia.

309. Atherina waigiensis Quoy & Gaimard. Waigiu.

Atherina cylindrica Cuvier & Valenciennes.

310. Atherina uisila Jordan and Seale, new species. *Uisila.*

Head 4.35 in length; depth 7; greatest width 7.40; eye 2.75 in head; snout 4; interorbital equal to eye; dorsal VII-I, 10; anal I, 12; scales 2-42-3; maxillary extending to below anterior margin of eye.

Body somewhat conical; head as wide as deep; interorbital space flat with two narrow grooves, gillrakers equal in length to pupil, about 25 on lower limb; a single row of minute teeth in jaws, patches of minute teeth on vomer and palatines; origin of dorsal nearer tip of snout than base of caudal, its longest spine equal to eye; origin of soft dorsal slightly posterior to origin of anal; base of soft dorsal 2.50 in head; base of anal 1.75 in head; the longest rays of soft dorsal and anal equal to eye; pectoral 1.50 in head; ventral 2; caudal 1.20, deeply emarginate; 18 rows of scales in front of spinous dorsal; pectoral reaching sixth scale of lateral line; origin of spinous dorsal over the sixteenth scale of lateral line; opercle and preopercle entire.

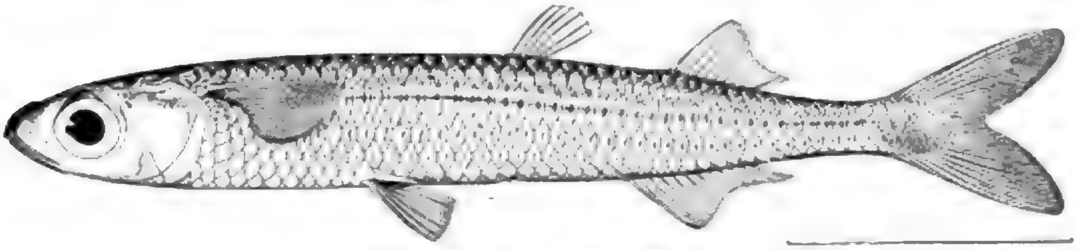

FIG. 23.—*Atherina uisila* Jordan & Seale, new species. Type.

Color in life, olive; a lateral band with a brighter streak above; lower jaw blue; a black band across pectoral, fins otherwise plain. Color in spirits, below the lateral stripe white with slight wash of pale green; margin of scales with or without fine black dots; a wide stripe of bright silver from opercle to base of caudal, at its widest point this stripe equal in width to the pupil; scales of lateral line in some specimens with darker centers, which give the appearance of a slightly darker line in the upper third of the silvery line; above the stripe the scales have darker margins and are punctulate with minute blue dots, the ground color being pale green; pectoral with a slight wash of dusky, other fins white; opercle silvery.

This species is near *Atherina lacunosa*, but seems to be different.

Forty specimens from Apia. The type is no. 51726, U. S. National Museum, length 3.75 inches.

311. Atherina insularum Jordan & Evermann. Hawaii.

Family MELANOTÆNIIDÆ.

RHOMBATRACTUS Gill.[a] (*Aristeus* Castelnau; preoccupied.)

312. Rhombatractus novæguineæ (Ramsay & Ogilby). Strickland River, New Guinea.

Nematocentris novæ-guineæ Ramsay & Ogilby, Proc. Linn. Soc. N. S. Wales 1886, 13, **Strickland River.**

313. Rhombatractus rubrostriatus (Ramsay & Ogilby). Strickland River, New Guinea.

314. Rhombatractus goldiei (Macleay).

Aristeus goldiei Macleay, Proc. Linn. Soc. N. S. W. 1883, 269, **Goldie River (New Guinea).**

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[a] See Ogilby, Proc. Linn. Soc. N. S. W. 1896, 124.

Family MUGILIDÆ.

MUGIL Linnæus.

315. Mugil cephalus Linnæus. Hawaii; Raiatea; Tahiti; New Guinea (Macleay); Nukahiva and Solomon Is. (Seale); Mediterranean; Atlantic coasts of United States; Panama; southern California; Japan; Red Sea.

(*Mugil œur* Forskål; *Mugil cephalotus* Cuvier & Valenciennes.)

316. Mugil caldwelli Fowler. Samoa.

Mugil caldwelli Fowler, Proc. Ac. Nat. Sci. Phila. 1900, 524, **Samoa.**

This species, not recognized by us in Samoa, is probably based on the young of some other species, perhaps the common mullet of Oceania, which we have been unable to separate from the European *Mugil cephalus* or the Asiatic *Mugil œur.*

317. Mugil broussoneti Cuvier & Valenciennes. Cook Is.

318. Mugil tongæ Günther. Tonga.

319. Mugil planiceps Cuvier & Valenciennes. Guam; East Indies.

320. Mugil kelaarti Günther. Tahiti; Raiatea (Seale); East Indies.

321. Mugil kandavensis Günther. Kandavu; Fiji.

322. Mugil perusi Cuvier & Valenciennes. Vanicolo.

323. Mugil argenteus Quoy & Gaimard. Samoa (Günther); Australia.

This species, recorded from Samoa, was not seen by us.

324. Mugil sundanensis Bleeker. New Guinea (Macleay); East Indies.

LIZA Jordan & Swain.

325. Liza melinoptera (Cuvier & Valenciennes). *Afa; Fuo'afa.* Vanicolo; Tonga; Samoa.

This mullet, known by the honey-colored (*μέλις*) caudal fin and by the black pectoral, is very abundant about Samoa, and reaches a large size. About 20 specimens were taken. The name *melinoptera* (not *melanoptera*) refers to the yellow vertical fins, not to the black pectoral.

Life colors of a specimen from Apia 15 inches long: Very pale olive, silvery below; faint narrow lines along series of scales; lips pale; first dorsal pale gray, the spines dark; soft dorsal dusky, yellowish at tip; caudal pale soiled yellow; anal blackish, yellowish at tip, the last rays colorless; ventral pure whitish; pectoral mostly deep sooty black, the lower rays grayish.

Another specimen from Apia, young, with scales 26–10, anal III, 9, had first dorsal, second dorsal, and most of pectoral jet black; ventral blackish at base, edge yellowish; caudal and anal blackish washed with deep yellow, edge blackish; iris dark brown. Life colors of young specimens (scales 26) from Pago Pago, back with two or three yellowish cross blotches; pectoral black; caudal bright yellow, even in very young examples; anal yellow; ventral tipped with pale yellow.

326. Liza cæruleomaculata Lacépède. *Anae; 'Ana'analagi.* Guam; New Guinea; Samoa; East Indies.

Mugil cæruleomaculatus Lacépède, Hist. Nat. Poiss., V, 385, 1803, **Mauritius.**

Mugil axillaris Cuvier & Valenciennes, Hist. Nat. Poiss., XI, 131, 1836, **Mauritius, New Guinea.** Günther, Cat., III, 444. Seale, Bishop Mus. 1901, 66, Guam. Günther, Fische der Südsee, 216, taf. CXX, fig. B, Samoa, Red Sea, Seychelles. *Agonostomus dorsalis* Streets, Bull. U. S. Nat. Mus., VII, 102, 1877, **Samoa;** very young.

Life colors of a specimen from Apia, silvery, darker above; no stripes; fins pale; caudal dark at tip; a dark axillary spot; pectoral dull yellowish; iris silvery brownish. Scales 39; anal III, 9.

This is a large mullet, recognizable by the blue spot at the base of the pectoral. It is common about Samoa, where about 25 specimens were preserved.

327. Liza troscheli (Bleeker). *Ana.* Samoa; New Guinea; East Indies.

Mugil troschelii Bleeker, Nat. Tijd., XVI, 277, **Java.** Gunther, Cat., III, 448, Ceylon, Borneo.

Mugil borneensis Bleeker, Nat. Tijd., II, 1851, 201, East Indies. Kner, Novara Fische, 228, **Tahiti.** Gunther, Cat., III, 448. Gunther, Fische der Südsee, 218, Tahiti.

Mugil compressus, Gunther, Fische der Sudsee, 217, taf. CXXIII, fig. A, Samoa; not type.

Life colors of a specimen from Pago Pago, olivaceous, dull and pale, very faint streaks along the rows of scales; anal dusky; caudal dull, colorless, with a dark streak along its whole margin above, below and behind. Anal III, 9; scales 32; maxillary uncovered; eye 3.5 to 4 in head, hence smaller than in the descriptions of *L. troscheli*.

One specimen from Apia had a slight brassy luster in life, and faint olive lateral stripes. Another was brownish above, the sides silvery, with the barest trace of striations; fins all plain, the caudal dusky at tip.

This species is very common about Samoa, entering the river mouths and brackish waters. About 30 specimens were taken.

328. Liza compressa (Günther). Normanby I., New Guinea (Macleay).

329. Liza neocaledonica (Castelnau). New Caledonia.

Mugil neocaledonicus Castelnau, 1873, 116, **New Caledonia.**

330. Liza waigiensis (Quoy & Gaimard). Waigiu; New Guinea; Bougainville Is. (Peters); Tahiti; Guam; Mangareva; New Hebrides; Solomon Is.; Raiatea and Rarotonga (Seale); East Indies.

331. Liza papillosa (Macleay). Normanby I.

Mugil papillosus Macleay, Proc. Linn. Soc. N. S. W. 1883, 270.

MYXUS Günther.

332. Myxus leuciscus Günther. Rarotonga, Cook Is.; Makatea (Seale).

CHÆNOMUGIL Gill.

333. Chænomugil chaptali (Eydoux & Souleyet). Hawaii; Kingsmill; Laysan.

(*Myxus pacificus* Steindachner.)

334. Chænomugil nauticus Bryan & Herre. Marcus I.

Chænomugil nauticus Bryan & Herre, Bishop Museum 1903, 127, **Marcus I.**

QUERIMANA Jordan & Swain.

335. Querimana crenilabis (Forster). Tahiti; Tanna; Paumotu; Kingsmill; Ponape; New Ireland; Christmas I.; Red Sea.

ÆSCHRICHTHYS Macleay.

336. Æschrichthys goldiei Macleay. Goldie River, New Guinea.

Æschrichthys goldiei Macleay, Proc. Linn. Soc. N. S. W. 1883, 5, **Goldie River.**

AGONOSTOMUS Bennett.

337. Agonostomus plicatilis (Cuvier & Valenciennes). Rivers of New Hebrides; New Caledonia.

338. Agonostomus loaloa (Macdonald). Fiji.

Gonotomyxus loaloa Macdonald, Proc. Zool. Soc. N. S. W. 1869, 38, with plate, **rivers of Viti Levu (Fiji).**

Family SPHYRÆNIDÆ.

SPHYRÆNA Linnæus.

339. Sphyræna obtusata Cuvier & Valenciennes. *Saputu.* Samoa; Fiji; Guam; New Guinea (Macleay); Faté in the New Hebrides (Seale); East Indies.

One specimen of this species was taken at Apia. It is apparently the species figured by Günther in the Fische der Südsee.

Life colors, olive green, below white with bright reflections; sides with two lateral stripes of dark olive, the lower continuous, the upper along lateral line of rounded, confluent blotches; caudal rather bright olive yellow, dusky edged; lower fins white; upper pale olive; snout green. Scales very large, 76.

340. Sphyræna forsteri Cuvier & Valenciennes. Samoa; Tahiti; Vavau; New Guinea.

Of this species, we have one specimen from Apia. It agrees fairly with Dr. Günther's figure in the Fische der Südsee. The *Sphyræna forsteri* of Steindachner from Mexico is a very distinct species, *Sphyræna ensis* Jordan & Gilbert.

Life colors of the specimen from Apia: Oblique blotch on opercle and base of pectoral; black blotch on dorsal and anal; caudal largely blackish; ventral and pectoral pale; obscure dark, short bars along sides. Scales 94; pectoral not reaching quite to dorsal; ventral farther.

341. Sphyræna helleri Jenkins. Hawaii.

This is the offshore small-scaled species, known in Hawaii as *kawalea*.

342. Sphyræna snodgrassi Jenkins. Hawaii.

This is the large-scaled species, known as *kaku* in Honolulu.

343. Sphyræna grandisquamis Steindachner. Pacific Ocean, exact locality unknown.

Sphyræna grandisquamis Steindachner, Sitz. Ak. Wiss. Wien 1866, 446.

344. Sphyræna megalolepis Peters. New Ireland.

Sphyræna megalolepis Peters, Berl. Mon. 1876, 842, **New Ireland.**

345. Sphyræna kenie Klunzinger. Bougainville Is.; Red Sea.

Sphyræna kenie Klunzinger, Synopsis, I, 823, 1870, **Red Sea.** Klunzinger, Roth. Meer, 129. Peters, Berl. Mon. 1876, 842, **Bougainville Is.**

Family POLYNEMIDÆ.

POLYDACTYLUS Rafinesque.

346. Polydactylus plebeius (Broussonet). *Umiumia.* Tahiti; Samoa; Solomon Is.; New Britain; Tahiti and Nukahiva (Seale); East Indies.

Polynemus plebeius Broussonet, Ich. Decas., fig. 309, 1788, **Tahiti.**

Polynemus lineatus Lacépède, Hist. Nat. Poiss., v, pl. 13, fig. 2, 1803, **Ile de France.** Günther, Cat., ii, 227, Samoa, Solomon Is., Amboyna.

Polynemus plebeius Peters, Berl. Mon. 1876, 835, New Britain.

Polynemus plebeius Günther, Fische der Südsee, 103, pl. LXXVI, fig. A, Amboina; not of Günther, Cat., ii, 329.

Polynemus tæniatus Günther, Cat., 11, 526, 1860, **Amboina and Guadalcanar, Solomon Is.**

This is evidently the original *Polynemus plebeius* of Broussonet, which has been much confused by subsequent authors. It was well described by Günther under the name of *Polynemus lineatus*, and earlier described by Lacépède under the same name. It is common at Apia, where 6 specimens were taken with the hook in the ship channel, and is valued as a food fish. Scales 55; 5 pectoral filaments.

The adults are very sharply striped, the dark lines along the rows of scales being conspicuous. Young examples do not show these lines clearly, and these accord better with the figure given by Broussonet. An adult example from Apia in life was white with streaks of olive brown. A young example from Pago Pago in life was entirely silvery, the fins pale with dark dots, pectoral a little more yellowish, no dark spot on base of lateral line.

347. Polydactylus sexfilis (Cuvier & Valenciennes). Hawaii; Johnston I.; East Indies.

Family BERYCIDÆ.

MELAMPHAES Günther.

348. Melamphaes unicornis Gilbert. Deep seas of Hawaii.

CAULOLEPIS Gill.

349. Caulolepis longidens Gilbert. Deep seas of Hawaii.

Family POLYMIXIIDÆ.

POLYMIXIA Lowe.

350. Polymixia berndti Gilbert. Deep seas of Hawaii.

Family HOLOCENTRIDÆ.

MYRIPRISTIS Cuvier. *Malau.*

351. Myripristis murdjan (Forskål). *Manitinifi.* Hawaii; Samoa; Harvey Is.; Tahiti; Fiji; Paumotu Is.; Guam; Laysan; New Hebrides, Raiatea, and Rarotonga (Seale); East Indies.

This species is common throughout the South Seas. It is the most abundant of the genus about Hawaii, and is fairly plentiful at Samoa. It is distinguished by its large scales (30), by the presence of white edges on the soft vertical fins and the absence of black tips on dorsal and anal. There is always a dark bar across the gill-opening.

352. Myripristis intermedius (Günther). *Malau.* Samoa; Kingsmill; Harvey Is.; Tahiti; Galapagos Is.

Myripristis murdjan, var. *intermedia* Günther, Fische der Südsee, 92, **Samoa, Harvey, Kingsmill, Tahiti.**

This form is common at Samoa, where about 20 examples were taken. It differs from *M. murdjan* chiefly or entirely in the presence of a black blotch on the tip of the soft dorsal and anal. Dr. Günther regards it as a mere color variation of *M. murdjan.* We should take a similar view were it not for the fact noted by Dr. Klunzinger, that in the Red Sea, and in Hawaii, where *M. murdjan* is abundant, no specimens of this type have been taken.

A specimen from the Galapagos Islands, collected by Snodgrass and Heller and recorded as *M. murdjan*, has black tips to the dorsal and anal, and would be referable to *M. intermedius.*

Color deep red, dusky on dorsal and anal, fins all bright red, pale-edged in front.

353. Myripristis adustus Bleeker. *Malau uo.* Samoa; Tahiti; Paumotu Is.; Harvey Is.; Kingsmill; New Guinea; Marcus I.; Shortland I. (Seale); East Indies.

Myripristis adustus Bleeker, Amboina, III, 18, East Indies. Günther Cat., I, 22, Amboina. Günther, Fische der Südsee, 92, *taf.* 62, Tahiti, as variety of *M. murdjan*, Samoa, Paumotu, Harvey I., Kingsmill I. Bryan & Herre, Bishop Museum, vol. II, no. 1, 128, Marcus I.

Myripristis botche, Day, Fishes of India, 169, not of Cuvier & Valenciennes.

This well-marked and handsome species is rather common about Samoa, where about 12 specimens were taken. It may be at once known from *M. murdjan* by the steel blue (not red) color, and especially by the broad black edging of both dorsals, and of the caudal and anal fins. In *M. intermedius* there is no black on the spinous dorsal or caudal.

Life colors of a specimen from Apia, gray tinged with reddish; edge of scales brown; a dark-brown blotch across opercle and axil; dorsal, anal and caudal pale pinkish gray at base, the edge broadly black, washed anteriorly with blood-red; spinous dorsal also mostly black; pectoral pale pinkish; ventral whitish.

354. Myripristis microphthalmus Bleeker. *Malau tea; Malau matapula.* Samoa; New Guinea (Macleay); Faté, New Hebrides (Seale); East Indies.

This species is very abundant at Samoa, where about 40 specimens were taken. It has the silvery luster and dark scale-edgings of *Myripristis adustus* without the deep red shades of *M. murdjan.* Life colors were noted in various specimens as follows:

(1) Specimen from Apia. Silvery red brown, lighter than in *M. murdjan*, each scale silvery with dark edges; opercular spot blood red, not black; same color on base of pectoral; fins paler; dorsal and anal with silvery base; dorsal, anal, caudal, and ventral with pale edge; spinous dorsal orange red, its base pale grayish, blotched with orange.

(2) Specimen from Pago Pago, very deep, scales 30, maxillary entire. Brownish, sides pinkish silvery, not very red; a blackish red cross-band on opercle, shoulder, and axil; first dorsal whitish at base, scarlet above; second dorsal, anal, and caudal pink, scarlet or orange at tips, and with a distinct white edge; pectoral pale; ventral dull orange, whitish-edged.

(3) Specimen called *malau matapulo*, or swelled-face; very deep; very large-scaled. Purplish black above, very silvery on side; a blood-red band from nape to axil; preopercle and opercle nearly white; spinous dorsal pinkish below, scarlet above; soft dorsal and anal pinkish behind, scarlet on lobes, with white edge; caudal red, orange behind, the edges slightly pale; ventral and pectoral reddish, ventral white-edged.

Larger examples more red, with dusky behind pale edges of dorsal and anal; fins all bright red except white edgings.

(4) Red, dusky on dorsal and anal; fins all bright red, pale-edged in front.

(5) Larger specimen. Dorsal clear deep red.

(6) Bright clear red, the scales a little paler on centers; first dorsal bright red, the tips scarlet; other vertical fins clear red with distinct pale edges and no blackish; no stripes along anterior edge; ventral deep red with pale edge; pectoral clear red; a blackish opercular axil bar.

355. Myripristis hexagonus (Lacépède). Samoa; Mauritius.

Lutjanus hexagonus Lacépède, Hist. Nat. Poiss., IV, 213, 1802, **Mauritius.**
Myripristis hexagonus, Cuvier & Valenciennes, Hist. Nat. Poiss., III. 171. Quoy & Gaimard, Voy. Astrolabe, 5, pl. 14. Gunther, Cat., I. 27.

We refer to this species, with some doubt, two specimens, large-scaled, with little black on the opercle which ends in about five points, the one larger than the others. It is near *Myripristis murdjan*, and still nearer to *Myripristis berndti* of Hawaii.

Life colors of a specimen from Apia, light brick-red, the sides rather silvery, and no dark lines; a darker red patch on opercle and axil; a silvery crescent on iris behind; fins all red, the spinous dorsal paler at base, the others darker on lobes; anal and caudal with very inconspicuous pale edging.

356. Myripristis berndti Jordan & Evermann. Hawaii.

357. Myripristis chryseres Jordan & Evermann. Hawaii.

358. Myripristis symmetricus Jordan & Evermann. Hawaii.

359. Myripristis argyromus Jordan & Evermann. Hawaii.

360. Myripristis sanguineus Jordan & Seale, new species. *Malau ula; Segasega.* Tahiti; Samoa.

Head 3.4 in body; depth 2.50; eye 2.50 in head; dorsal X-I, 14; anal IV, 13; scales 4-38-7.

Body elongate, deep and compressed; head blunt, its length less than its depth; snout short, its length from the upper nostril equal to pupil; premaxillary slightly protractile; maxillary reaching to a line below the posterior edge of pupil, its distal end broad, 4.50 in head, its lower posterior margin armed with blunt teeth; lower mandible 1.50 in head; bands of small teeth in jaws, vomer, and palatines; a patch of enlarged blunt outer teeth on each side of upper and lower jaw; gillrakers numerous, long and strong; interorbital space 3.85 in head; opercle striate and denticulate, with one small spine at angle; scales all striate and toothed; a row of modified scales over the nuchal region; origin of dorsal about even with lower base of ventrals and on line with the third scale of the lateral line; dorsal spines slender, the first 2.75 in head, the third longest, 2 in head; anterior dorsal and anal rays somewhat produced, their length 1.50 in head; third anal spine strongest, the fourth longest, equal to orbit; caudal emarginate; pectoral reaching to eleventh scale of the lateral line.

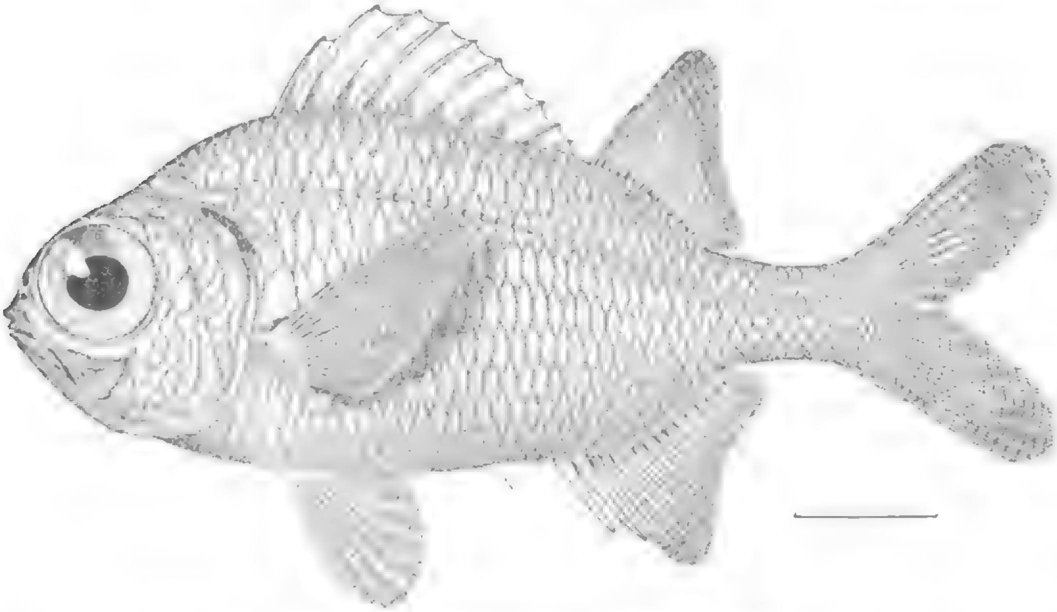

FIG. 21.—*Myripristis sanguineus* Jordan & Seale, new species. Type.

Color in life deep red, a black opercular spot; fins all red, the dorsal pale red with the margin deep crimson; outer margin of soft dorsal and the anal also a dark red.

Color in spirits pale yellowish, the fins a brighter yellowish; a dusky blotch at posterior margin of opercle, and a dusky wash in axil of pectoral.

One specimen, the type (no. 51721, U. S. National Museum), from Apia. Two other specimens, from Tahiti, Society Islands, are in the Bishop Museum, Honolulu. This species is distinguished by the much enlarged front teeth. It is close to *Myripristis argyromus* and *M. symmetricus.*

361. Myripristis pralinius Cuvier & Valenciennes. *Mamo; Malau mamo.* Port Praslin, New Ireland; Samoa; East Indies.

This species is very abundant at Samoa, where about 50 examples were taken. Our specimens agree well with the account of Günther and Sauvage. The small scales, the serrated maxillary, and the dark bar at the gill-opening are characteristic.

Life colors of a specimen from Apia crimson red, the centers of the scales not much lighter, the lower parts rosy; opercular spot deep red, almost black, base of pectoral deep red; fins bright rose, dorsal, caudal, and ventral all edged with white; shade of fins same as body; first dorsal deep red, paler at base.

362. Myripristis carneus Ramsay & Ogilby. Admiralty Is.

Myripristis carneus Ramsay & Ogilby, Proc. Linn. Soc. N. S. W. 1886, 474.

363. Myripristis parvidens Bleeker. New Ireland (Sauvage); East Indies.

364. Myripristis multiradiatus Günther. Vavau; Tonga; Hawaii; Samoa.

A species identical with the Hawaiian species called by us *Myripristis multiradiatus*, which is abundant at Honolulu, is very common at Samoa. It is probably the true *multiradiatus*, though we find no specimen with more than 16 dorsal rays. In the type from Vavau Dr. Günther found 18. The species is extremely close to *M. pralinius.*

Life colors of a specimen from Pago Pago light bright red; darker green across opercle, shoulder and axil; spinous dorsal scarlet, deepest on edges; other fins red like the body; pectoral, dorsal, anal and caudal with an anterior pale edge; eye very large, maxillary entire.

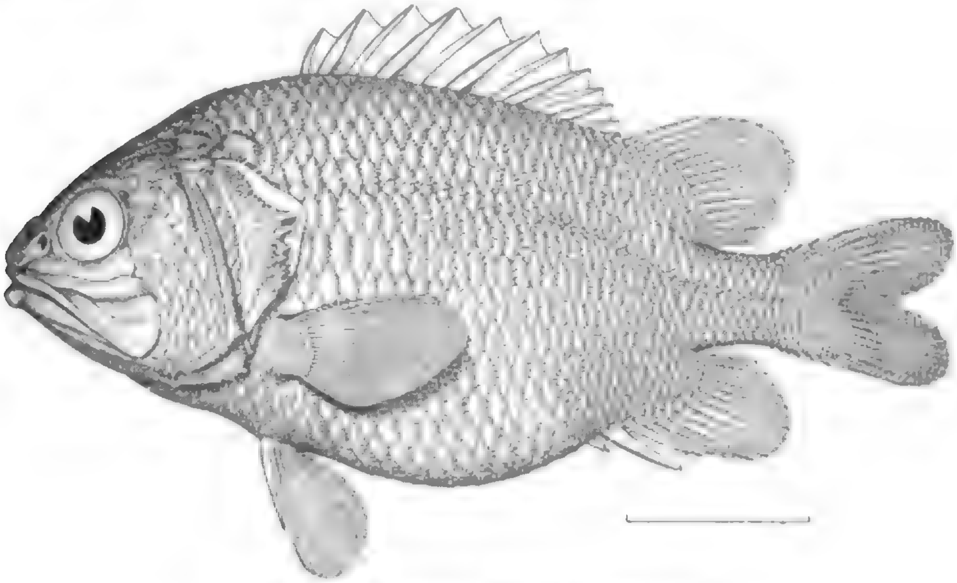

Fig. 25.—*Holotrachys lima* (Cuvier & Valenciennes).

HOLOTRACHYS Günther. (*Harpage* De Vis.)

365. Holotrachys lima (Cuvier & Valenciennes). *Malau mutu; Mutu.* Hawaii; Samoa; Tahiti; Laysan; Ile de France.

This species is very common at Samoa, as also about Hawaii. It is of small size and is uniform brick-red in color.

366. **Holotrachys roseus** (De Vis). South Seas.

Harpage rosea De Vis, Proc. Linn. Soc. N. S. W. 1884, 448, **South Seas.**

This species is unknown to us. It is very close to *H. lima*, and is probably the same.

OSTICHTHYS Langsdorf.

367. **Ostichthys pillwaxi** Steindachner. Hawaii.

HOLOCENTRUS (Artedi) Gronow. *Malau.*

368. **Holocentrus spinifer** Forskål. *Malau toa.* Samoa; Hawaii; Borabora; Waigiu; Papua; Johnston I.; Thornton I.; Vanicolo; Tonga; Vavau; New Hebrides; Solomon Is.; Raiatea (Seale); East Indies.

Holocentrus leo Cuvier & Valenciennes, Hist. Nat. Poiss., III, 204, 1829, **Borabora and New Guinea**; not *Holocentrum spiniferum* Cuvier & Valenciennes and Sauvage.

This large species is common at Samoa, and ranges from Hawaii, where it is not rare, to the Red Sea and Madagascar. It is known by its deep body and narrow, convex profile. It much resembles *H. caudimaculatus*, and the name *spinifer* is adopted for the latter species by Valenciennes and Sauvage; but as Forskål speaks of the dark spots behind the eye, which is characteristic of the species called *Holocentrus leo*, we agree with Ruppell, Bleeker, Günther, and Klunzinger in regarding the present species as the true *spinifer*, *leo* being a synonym.

Forskål and Klunzinger state that the dorsal spines of this species are envenomed. Both this species and *H. caudimaculatus* are common in the Red Sea.

Life colors of a specimen from Apia, deep red, scales with golden edges; no lengthwise stripes or violet streaks; preopercle and opercle blood-red above; axil blood-red; first dorsal same color, unmarked; dorsal, anal, and caudal scarlet, the upper and lower part of caudal redder; third and fourth spines red; ventrals scarlet, the spine pink; pectoral scarlet; cheek pale brassy red, no white stripes, except a faint streak below eye along upper edge of cheek, and a paler edge behind opercular spot. One specimen with a sharp white stripe above opercular spine.

Life colors of another specimen from Apia, deep red, scales with narrow pale edges; deep reddish black spot on opercle and across to axil; dorsal red, edged with deeper red; fins all red without pale edging; membrane of third anal spine deep red.

369. **Holocentrus caudimaculatus** Rüppell. *Tamalau mumu; Tameno mumu.* Samoa; Tahiti (Seale); Palau Is.; Gilbert Is.; New Guinea; East Indies.

Holocentrum spiniferum Cuvier & Valenciennes, and of Sauvage; *Holocentrum leonoides* Bleeker.

This species is abundant about Samoa, and westward to the Red sea. It is near *H. spinifer* but the profile is broader and not concave, and there are other differences well expressed by Klunzinger and by Sauvage. The color is deeper than in *H. spinifer*, and the white spot on the back of the tail is rarely wanting in *H. caudimaculatus.* In *H. spinifer* this is not found, but is represented by a trace of paler color.

Life colors of a specimen from Apia, all deep red; faint violet streaks on lower parts; a faint line down and backward from eye; axil deep red; fins all deep red; anal spine and front edge of ventral only whitish; a large whitish black blotch on the back of the tail behind dorsal.

370. **Holocentrus violaceus** Bleeker. *Malau tifi; Malau uli.* Samoa; New Guinea (Macleay); Amboina.

This very strongly marked species is common at Samoa, where about a dozen specimens were taken. It is deep violet-brown, not red, with a vertical pale streak on each scale, and a white blotch on the back of each scale. It is not known from Hawaii.

Life colors of a specimen from Apia called *malau tifa* and *malau uli*, blackish red, a vertical bar of violet silvery at base of each scale; head mostly clear dark red; a blackish spot on opercular membrane; a blood-red axillary spot; a darker red spot on upper part of opercle; first dorsal dark red with a whitish edge and a deep red line below it; second dorsal, anal, and caudal dark red with a darker anterior edge; a pink spot on back of tail; ventral red, the spine bluish; first spine and first ray of anal moderately deeper red; pectoral red; mouth small.

Life colors of a specimen from Pago Pago called *malau tifa* (pearl shell), violet pearly reflections; the color very dark, the violet pearly bars on each scale below conspicuous; a bright pink spot on back of tail.

371. Holocentrus binotatus Quoy & Gaimard. Samoa; Guam; Papua; Tonga; Solomon Is.

This species is rather common about Samoa, where about 30 specimens were taken. Usually one or two small dark spots are present on the membranes of the front of the spinous dorsal. There is little doubt that the original *H. binotatum* is the species called *unipunctatum* by Günther.

Life colors of a specimen from Apia, very deep red all over, with faint blue-black streaks, about 7 in number; head almost plain red, with two faint cheek stripes; fins all deep red, the dorsal with a row of dark spots and dark edges.

Life colors of a specimen from Pago Pago, very bright red, with streaks of shining golden; fins all deep red, unmarked, the vertical fins a little darker on front edge; a slightly darker spot on membranes of first two dorsal spines.

372. Holocentrus erythræus Günther. Hawaii; Samoa; New Hebrides; Tahiti; Harvey Is.; Kingsmill; Tahiti; Paumotu Is.; Johnston I.; Solomon Is.

Of this large and handsome species one small specimen was taken by us at Samoa. The fish is rather rare in deeper waters about Hawaii.

373. Holocentrus furcatus Günther. South Seas, probably New Hebrides.

374. Holocentrus xantherythrus Jordan & Evermann. Hawaii.

375. Holocentrus tiere Lesson. Samoa; Tahita; Thornton I.

Holocentrum tiere (Lesson), Cuvier & Valenciennes, Hist. Nat. Poiss., III, 202, 1829, **Tahiti.** Lesson, Voy. Coquille, II, 221, 1830, Tahiti. Günther, Cat., I, 45.

Holocentrum pœcilopterum Bleeker, Kokos Eilanden, 356. Bleeker, Atlas, Cocos Island. Günther, Cat., I, 35.

Holocentrus polynesiæ Fowler, Proc. Ac. Nat. Sci. Phila. 1904, 229. **Thornton I.**

This species is known when adult and in good condition by the two rows of pale spots on the dorsal fin. It is rather common at Samoa, where about 12 specimens were taken. *H. polynesiæ* seems to be based on a specimen in which the dorsal color has faded. *Holocentrum tiere* must be the same species. The elongate, faintly striped body, the rather large mouth, the ragged suborbital, the low weak dorsal spines, the subequal and strong opercular spines, as shown in Lesson's figure, are all traits of the species called *H. pœcilopterus.*

Life colors of a specimen from Apia, deep crimson red; lower half with bright violet streaks; axil deeper red; dorsal deep red with a row of white spots and tips white; other fins deep red; ventral with paler edge and darker streak, fourth anal spine in a dark streak; pectoral red; head with deeper red blotches, but no white. Another specimen from Apia in life was red, rather bright, the sides silvery; cheek silvery with a red streak; no streaks along scales; dorsal edged with dark red with white spots; red at base; vertical fins red, the edges scarcely darker; ventral pink, axil red; pectoral pink.

376. Holocentrus tiereoides Bleeker. Marcus I.; New Hebrides; Solomon Is.; Tahiti (Seale); Amboina.

This species is known to us from the example taken by Bryan and Herre, which agrees well with Bleeker's account. The species is evidently very close to *H. tiere,* but the scales are much larger (40 instead of 50).

377. Holocentrus punctatissimus Cuvier & Valenciennes. *Malau faiumu.* Tahiti; Samoa; Hawaii; Strong I.; Guam; Marshall Is.; Paumotu Is.; Laysan; Aneiteum; Tabuai; Mangareva; Rarotonga; Fatè; Makatea and Shortland I. (Seale).

Holocentrum punctatissimum Cuvier & Valenciennes, Hist. Nat. Poiss., III, 215, 1829, **Caroline Is.**

Holocentrum stercus-muscarum Cuvier & Valenciennes, op. cit., VII, 503, 1831.

Holocentrum diploxiphus Günther, Proc. Zool. Soc. 1871, 660. Günther, Fische der Südsee, 97, Samoa, Marshall Is., Tahiti, Paumotu, Aneiteum.

Holocentrus gracilispinis Fowler, Proc. Ac. Nat. Sci. Phila. 1904, 228, **Honolulu.**

Holocentrus gladispinis Fowler, Proc. Ac. Nat. Sci. Phila. 1904, 225, **Tahiti.**

This species is common about Samoa, where about 50 specimens were taken. It is also abundant about Honolulu. The form of the body is characteristic, and the silvery color is usually, but not always, obscured by dark points irregularly scattered, giving the fish a soiled appearance.

H. gracilispinis, based on our own collections from Honolulu, we can not separate from Samoan specimens. *H. gladispinis* is based on an example from Tahiti with the preopercular spine a little longer. The color of the dorsal is usually characteristic, but the marks often fade in spirits. This species is not recorded from the East Indies, where the closely related *H. lacteoguttatus* seems to take its place

Life colors of a specimen from Apia called *malau faiumu*, freckled red, dark across gill-opening; iris golden; first dorsal deep red on edge, other fins brick red, scarcely edged with paler; ventrals brick red. A specimen from Pago Pago was pinkish, soiled by dark dots; dorsal deep red on edge, pale at base; faint dark streaks on rows of scales; a red dash across cheek; fins light red; a dark streak along anal.

378. Holocentrus lacteoguttatus Cuvier & Valenciennes. New Guinea; East Indies.

Holocentrus lacteo-guttatum Cuvier & Valenciennes, Hist. Nat. Poiss., III, 214, **East Indies.**
Holocentrus argenteum Quoy & Gaimard, Voy. Astrolabe, 677, 1835, Papua. Cuvier & Valenciennes, op. cit., III, 215.

This species is not known to us. It has not been recorded to the eastward of New Guinea. According to Klunzinger, the type of *H. argenteus*, examined by him belongs to the species, for which we adopt the name *lacteoguttatus*.

379. Holocentrus diadema (Lacépède). *Malau tusitusi; Malau päuli; Malau tui.* Hawaii; Samoa; Tonga; Tahiti; Borabora; Laysan; Guam; Marcus I.; New Hebrides (Seale); East Indies.

This small species, always known by its black spinous dorsal and the alternate stripes of white and red on the body, is very common at Samoa, and equally so at Hawaii. It is in general the most abundant species of *Holocentrus* in the Pacific Ocean.

Life colors of a specimen from Pago Pago called *malau päuli*, red, with white stripes; dorsal dusky, a continuous stripe, same as from Honolulu.

380. Holocentrus ruber (Forskål). Louisiades; East Indies; China; not certainly known from the South Seas.

381. Holocentrus praslin Lacépède. Samoa; Ruikiu Is.

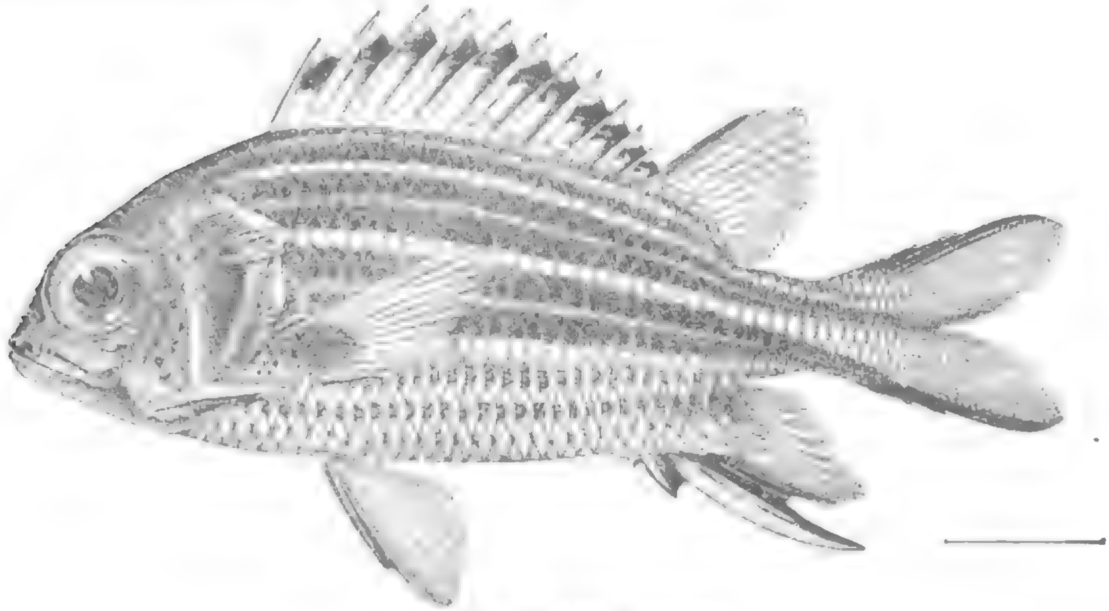

FIG. 26.—*Holocentrus praslin* Lacépède.

This species, known by its very dark lateral stripes, which seem black in spirits, is common at Samoa, but is not known from Hawaii. Life colors were noted as follows in various specimens:

(1) From Apia. Deep red, very bright, paler below; 10 longitudinal streaks, narrow and sharply defined, the four uppermost light crimson, the rest almost pure white, with brownish edge; a white stripe downward and backward from eye, a red one and a white one above it; spinous dorsal

blood red with an interrupted row of whitish spots and a whitish tip; other fins clear red, caudal with a blood red edge, as also a stripe along fourth anal spine; ventral similarly striped; pectoral pinkish.

(2) From Apia. Whitish, olive shaded; 9 stripes of brownish black, unequal in width and depth of color, separated by white and grayish and pinkish stripes, the stripe on level of eye broad and white, the two black stripes above it confluent behind as also the two below it; the white stripe from axil of anal to axil of pectoral also broad; opercle reddish black; lower part of head and breast soiled gray with blackish stripes; dorsal grayish white with blackish median band; soft dorsal light yellow, edged before with dark maroon; caudal light clear yellow, edged above and below with maroon black; anal lighter yellow, with darker anterior stripe and a black maroon blotch at base; a maroon black bar below soft dorsal made of two coalescent black stripes; ventral yellow, edged with maroon and white; pectoral reddish, the axil blackish.

(3) From Pago Pago. Very dark blood red, with whitish pink stripes; dorsal white, with median black stripe; second dorsal yellowish, with red anterior margin and blackish blotch at base; caudal yellow with maroon stripes; anal yellowish with a black stripe and a spot at base; ventral yellowish, with white and black stripe.

(4) From Apia. Deep lustrous coppery red, paler below, the dark alternating with pale stripes, the red very deep and bronze shaded above, growing paler and more diffuse below; about 7 streaks distinct; head blackish freckled bronze; dorsal dark blood red, mesially pale and pale at tips; soft dorsal, anal, and caudal golden, with maroon stripe anteriorly narrow on soft dorsal; ventral similar golden and maroon; breast soiled mottled brown and whitish; pectoral pale reddish brown.

Holocentrus ruber differs from this species chiefly in the plain colors, red striped with deeper red. Probably *Holocentrus praslin* is an "ontogenetic species" representing *H. ruber* on the coral reefs, and differing mainly in the much heightened coloration.

382. Holocentrus ensifer Jordan & Evermann. Hawaii; Mangareva (Seale).

383. Holocentrus bowiei Jordan & Snyder. Tahiti.

384. Holocentrus microstomus Günther. Samoa; Guam; Tonga; Hawaii; Kingsmill I.; Paumotu Is.; Harvey Is.; Tahiti; Tubuai; Raiatea and Rarotonga (Seale).

This species, well distinguished by its silvery body striped with dark, and by the dark area on the front of its spinous dorsal, is rather common about Samoa, where about 12 examples were taken. It is not rare about Honolulu. From *Holocentrus sammara*, which has somewhat the same coloration, it is known by the deeper body and smaller mouth. This species and the next, intermediate between *Holocentrus* and *Flammeo*, render the latter genus difficult of definition. We therefore place all the Pacific species in *Holocentrus*.

385. Holocentrus scythrops Jordan & Evermann. Hawaii; Laysan; East Indies.

(*Holocentrum argenteum* Bleeker & Steindachner, not of Quoy & Gaimard.)

This species is rather rare about Hawaii. It was not seen at Samoa. It has been once or twice described as *Holocentrum argenteum*, but the true *argenteum*, as Klunzinger has shown, is a different species (*lacteoguttatus*)

386. Holocentrus lævis Günther. Samoa; Louisiades; Solomon Is.; New Britain; New Guinea; Amboina.

Holocentrum goldici Macleay, Proc. Linn. Soc. N. S. W. 1883, 352, **New Guinea.**
Holocentrum læve Günther, Cat., I, 47, **Louisiades, Guadalcanar, Amboyna.** Günther, Fische der Südsee, 101, taf. 65, fig. B.
Holocentrum novæ-brittaniæ De Vis, Proc. Linn. Soc. N. S. W. 1884, 447, **New Britain**; young.
Holocentrus achromopterus Fowler, Proc. Ac. Nat. Sci. Phila. 1904, 236, **Samoa.**
Holocentrum goldiei Macleay, Proc. Linn. Soc. N. S. W., VII, 1883, 352, **New Guinea.**

This species is rather common about the reefs of Samoa, where about 20 examples were taken. It resembles *H. sammara*, but the body is deeper and there is never any black on the spinous dorsal.

Life colors of a specimen from Pago Pago, the stripes less regular and fewer than in *H. sammara*, distinctly shown, the pale stripe on lateral line being dull red, dorsal paler, deep red between first and second spines, the white band much broader and more diffuse; caudal almost plain; darker red on edge of second dorsal and caudal, much deeper on anal; ventral paler red than in other; ventral and anal spines red.

387. Holocentrus sammara (Forskål). *Malau peapea.* Hawaii; Tahiti; Samoa; Borabora; Paumotu Is.; Solomon Is.; Guam; New Guinea; Thornton I.; Marquesas Is. (Seale); East Indies.

Labrus angulosus Lacépède, Hist. Nat. Poiss., III, 430, pl. 22, fig. 1, 1803.
Holocentrum christianum Cuvier & Valenciennes, Hist. Nat. Poiss., III, 219, 1829, **Red Sea.**
Holocentrum tahiticum Kner, Novara Fische, III, 1869, f. 2, pl. 16, **Tahiti.** Kner, Sitz. Ak. Wiss. Wien, 1864, 482, Tahiti.
Holocentrus fuscostriatus Seale, Bishop Mus., 1901, 69, **Guam.**
Holocentrus thorntonensis Fowler, Proc. Ac. Nat. Sci. Phila. 1904, 231, **Thornton I.** (young).

This handsome fish is very common on the reefs at Samoa, where about 100 examples were taken. It is rare about Hawaii.

The species varies considerably in the distinctness of the dark maroon lateral stripes, but the black on the first dorsal is never absent. In the young it takes the form of an ocellus. Such a young example is the type of *Holocentrus thorntonensis.* Life colors were noted as follows in various specimens:

(1) Specimen from Apia. Silvery, with golden, red, and greenish reflections; back with four stripes of dark maroon red, the second and third brightest; head dark red above, mostly silvery, with red wash below; lips flesh color; opercle dark red above; fins pale red, the spinous dorsal broadly edged with blood red; caudal with a maroon stripe in each lobe, anal and ventral also; no pale edging.

(2) From Apia. Olive, lustrous purplish above, coppery silvery below; each scale with a large distinct coppery black spot, these forming about ten stripes; cheek whitish with black spots; head wine-shaded on lips, snout, and opercle; preopercle white; dorsal maroon, whitish spots at base, tips white; front of dorsal with large black, red-washed blotch; soft dorsal, anal, and caudal golden yellow, with a long maroon stripe on anterior rays, covering most of caudal lobes; pectoral coppery reddish; ventral white.

(3) Young specimen from Apia. Red, with a large black blotch on front of spinous dorsal, a dark red stripe in each caudal lobe and on front of soft anal; a dark band across opercle.

(4) From Apia. Silvery rose; brownish above with stripes of rosy maroon, all but one indistinct, the bright one following course of lateral line; opercle dark maroon; dark band across base of pectoral; front of dorsal with very large blotch of maroon black, fin otherwise flesh-color, tips whitish; soft dorsal yellow, transparent behind, with maroon stripe in front; anal whitish with maroon stripe; pectoral and ventral nearly white; caudal pale orange, the lobes rosy maroon.

388. Holocentrus opercularis (Cuvier & Valenciennes). Tahiti; New Ireland; Samoa; Palau Is.; Paumotu Is.; Guam.

This strongly marked species is well figured by Dr. Günther. Two specimens were taken at Samoa.

Life colors of one from Pago Pago, light red, each scale with a darker center and a silvery edge; dark streaks along rows of scales; head red; opercle blood red; iris very red; first dorsal jet black, with a row of white spots at base and tip; second dorsal, anal, and caudal red, with a darker bar in front and a shade of orange behind; pectoral and ventral pink; pectoral red at base; a red shade down and back from eye. Mouth large; chin prominent; anal spine long; body slender.

Family LAMPRIDÆ.

LAMPRIS Retzius.

389. Lampris regia (Bonnaterre). Hawaii; all warm seas.

The name *Zeus regius* of Bonnaterre and that of *Zeus guttatus* of Brünnich, both 1788, antedate *Zeus luna* of Gmelin (1789). We do not know which of these first has actual priority, but *regius* is a name preferable to the commonplace and overworked specific name *guttatus.* It is true, however, that the name *guttatus* has been more generally used than that of *regius*, and the account given by Brünnich is the best found in any early author. Following the arbitrary rule which we have adopted, the name *regius* on page 72 in Bonnaterre's work antedates *guttatus* on page 398 in that of Brünnich.

Family ZEIDÆ.

STETHOPRISTIS Gilbert.

390. Stethopristis eos Gilbert. Deep seas of Hawaii.

CYTTOMIMUS Gill.

391. Cyttomimus stelgis Gilbert. Deep seas of Hawaii.

Family SCOMBRIDÆ.

SCOMBER (Artedi) Linnæus.

392. Scomber japonicus Houttuyn. Hawaii; California; Japan; Atlantic.
Scomber colias Gmelin.

393. Scomber microlepidotus Rüppell. Solomon Is. and New Hebrides (Seale); coasts of Asia.

394. Scomber chrysozonus Rüppell. Bougainville Is. (Peters, Berl. Mon. 1876, 836); Red Sea.

395. Scomber loo (Cuvier & Valenciennes). *Gu.* Samoa; Waigiu; Fiji; Palau Is.; New Guinea (Macleay); East Indies.

This well-marked mackerel is abundant in the open channels about the reefs of Samoa, and is an excellent food fish. The species is quite distinct from *Scomber kanagurta*, with which Günther has confounded it.

Life colors of a specimen from Apia, lustrous green, silvery below; round blackish green spots on sides of back.

AUXIS Cuvier.

396. Auxis thazard (Lacépède). Hawaii; New Guinea; warm seas.

GYMNOSARDA Gill.

397. Gymnosarda pelamis (Linnæus). Hawaii; warm seas.

398. Gymnosarda alleterata (Rafinesque). Hawaii; warm seas.

GERMO Jordan.

399. Germo germo (Lacépède). South Seas; Japan.
(*Thynnus albi* Schlegel.)

400. Germo macropterus (Schlegel). Hawaii; southern California; Japan.

This species is known by its elevated dorsal and anal, and especially by the citron-yellow finlets.

SARDA Cuvier.

401. Sarda chilensis (Cuvier & Valenciennes). Hawaii; California; Chile; Japan.

SCOMBEROMORUS Lacépède.

402. Scomberomorus commersoni Lacépède. New Guinea (Macleay); East Indies.

ACANTHOCYBIUM Gill.

403. Acanthocybium solandri (Cuvier & Valenciennes). Hawaii; warm seas.

Family LEPIDOPIDÆ.

RUVETTUS Cocco.

404. Ruvettus pretiosus Cocco. Hawaii; Japan; West Indies.

PROMETHICHTHYS Gill.

405. Promethichthys prometheus (Cuvier & Valenciennes). Hawaii; Tahiti; Australia; Japan.

LEMNISOMA Lesson. (*Gempylus* Cuvier & Valenciennes.)

406. Lemnisoma thyrsitoides Lesson. Hawaii; Tahiti; West Indies.
(*Gempylus serpens* and *Gempylus coluber* Cuvier & Valenciennes.)

Family XIPHIIDÆ.

407. Xiphias gladius Linnæus. Hawaii; warm seas.

Family CARANGIDÆ.

SCOMBEROIDES Lacépède.

408. Scomberoides sanctipetri (Cuvier & Valenciennes). *Lai.* Hawaii; Samoa; Kingsmill I.; Tahiti; Johnston I.

This widely diffused species is rather common about Samoa and Hawaii. A few specimens were taken in the channels of Apia.

409. Scomberoides toloöparah (Rüppell). Hawaii; New Ireland; Vanicolo; New Guinea (Macleay); East Indies.

410. Scomberoides lysan (Forskal). New Guinea (Macleay).

SERIOLA Cuvier.

411. Seriola purpurescens Schlegel. Hawaii; Japan.

412. Seriola sparna Jenkins. Hawaii.

NAUCRATES Rafinesque.

413. Naucrates ductor (Linnæus). Hawaii; Japan; warm seas.

ELAGATIS Bennett.

414. Elagatis bipinnulatus Quoy & Gaimard. Hawaii; Iles des Papous; New Britain (Peters); Solomon Is. (Seale); East Indies; West Indies.

MEGALASPIS[a] Bleeker.

415. Megalaspis cordyla (Linnæus). *Atualo.* Samoa; East Indies.

Common in the open channels in the reef.

DECAPTERUS Bleeker.

416. Decapterus pinnulatus (Eydoux & Souleyet). Hawaii; Raiatea; Tahiti; Bonin Is.; Paumotu Is.

(*Decapterus canonoides* Jenkins.)

This species is different from *Decapterus maruadsi* of Japan, and apparently also distinct from *Decapterus sanctæ-helenæ* of the Atlantic.

417. Decapterus lundini Jordan & Seale, new species. Samoa.

Head 3.75 in length; depth 3.20; eye 4 in head, 1.20 in snout; dorsal vi-i, 21-1; anal ii, 21-1; scales small, 95 in lateral line, of which 45 are modified with plates; interorbital, 4 in head; maxillary, 3, reaching to below the anterior margin of eye, all but its posterior third hidden under the preorbital.

Body elongate, compressed, fusiform; scales covering entire body and head; adipose eyelid well developed, covering entire eye except width of pupil; small teeth in single series on jaws and palatines, slightly enlarged teeth on vomer; very minute teeth on tongue; gillrakers shorter than width of eye, 24 on lower limb; preopercle entire, opercle with small rounded nick on upper margin; base of dorsal slightly greater than anal, its longest ray 1.85 in head; first ray of anal 2 in head;

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[a] The name *Megalaspis* Bleeker dates from 1851. At about the same time Angelin gave the same name to a genus of Trilobites. As to this Dr. Stejneger observes (in lit. Dec. 16, 1904): "Two straws point to the Trilobite's being the younger name. Bleeker's *Megalaspis* is mentioned in the 'Leistungen' for 1851. Angelin's name is not mentioned in the 'Leistungen' until 1852-3." There is also doubt for other reasons whether Angelin's paper appeared before 1852. We therefore retain *Megalaspis* for the genus of fishes.

pectoral 3.10 in length, extending to below the 8th dorsal ray; ventral 2 in head; caudal slightly less than head, 4.50 in length; depth of caudal peduncle, 2 in its width (with keels).

Color in spirits, silvery with wash of yellowish below, darker above, with about nine indistinct vertical brown bands as wide as eye and slightly greater than the interspaces on sides of body, fading out below lateral line; a distinct black opercular spot; a dusky wash on inner axil of pectoral; a dusky blotch on tip of snout and tip of lower jaw; a golden wash on preopercle; dorsal and anal yellowish-white with narrow dusky margin; pectoral, ventral, and caudal yellowish-white.

One specimen, type no. 51727, U. S. National Museum, from Pago Pago, length 7.25 inches, taken in a school of the common "atule" (*Trachurops*).

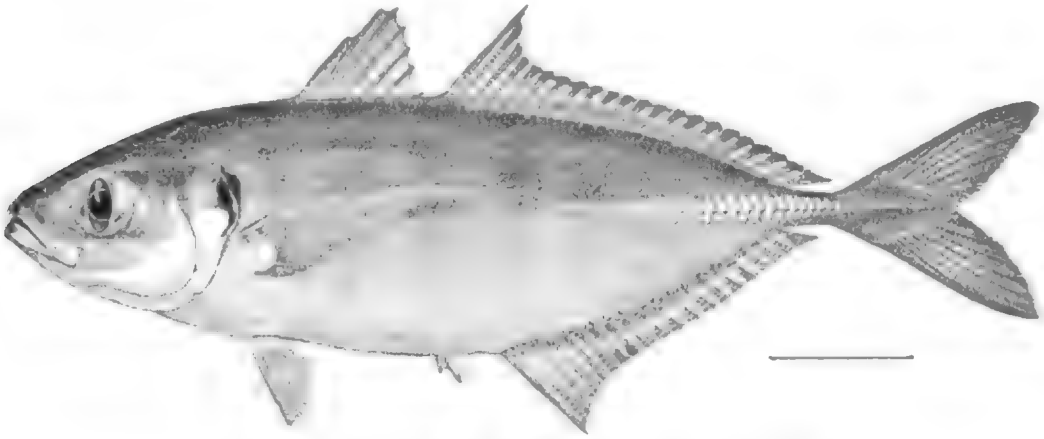

FIG. 27.—*Decapterus lundini* Jordan & Seale, new species. Type.

TRACHUROPS Gill.

In this genus there is much variation in the size of the eye. In *mauritiana* (= *torva*) the eye is smaller than in *crumenophthalma*. In the Japanese form it is still smaller. We can not yet clearly define these forms as different species.

418. Trachurops crumenophthalma (Bloch). *Atule.* Samoa; Hawaii; Tahiti; Solomon Is.; New Hebrides; Marquesas Is.; and Rarotonga (Seale); all warm seas.

This species is the commonest food-fish of Samoa, entering the harbors in great schools. The flesh is excellent. There is apparently no difference between *Trachurops torva* and the common *T. crumenophthalma* of the Atlantic.

CARANX (Commerson) Lacépède. (Including *Carangus* Griffith = *Tricopterus* Rafinesque, 1810.)

419. Caranx lugubris Poey. Kingsmill Is.; Rarotonga; Marquesas Is.; Tahiti and Solomon Is. (Seale); West Indies; Clarion Island; St. Helena.

420. Caranx melampygus Cuvier & Valenciennes. *Malauli.* Hawaii; Samoa; Marcus I.; New Guinea; Waigiu; Rawak; Austral Is.; Solomon Is. and New Hebrides (Seale); Clarion Is.; East Indies.

This species is the finest of the commoner food-fishes of Samoa, being especially excellent as chowder. It is abundant in the channels between the reefs, reaching a large size. Several scores of specimens were taken, a few being preserved.

Life colors of a specimen from Pago Pago, body light olive with darker olive spots; fins deep clear blue.

421. Caranx thompsoni Seale. Hawaii.

422. Caranx forsteri Cuvier & Valenciennes. *Ulua.* Samoa; Hawaii; Papua; Vanicolo; New Ireland; New Guinea; Tanna; Tahiti (Seale); East Indies.

The earliest name for the *ulua* seems to be that of *Caranx forsteri*. According to Sauvage (Poiss. Madagascar) the types of *Caranx sem* and *Caranx lessoni* have the breast naked. These must then go into the synonymy of *Carangus ignobilis*. *Caranx kleini* (Bloch), as Dr. Klunzinger has pointed out, is not the *ulua*, but some one of the species found in Hindustan. *Caranx sexfasciatus* is the banded species of the river mouths called *Carangus rhabdotus* by Jenkins. The name *Caranx hippos* has no pertinence to this species, having been based on a specimen of "*Caranx carangus*" from South Carolina. Sauvage recognizes *Carangus forsteri* as a species distinct from the *ulua*, but his figure of the type shows no differential characters. *Caranx peroni* and *Caranx belengeri* of Cuvier and Valenciennes are also based on the *ulua*.

In life the ulua is easily recognized by its yellow pectoral, the anal lobe being dusky, and the dorsal not edged with black. The breast is fully scaled. *Carangus marginatus* is similar, but has the dorsal edged with blackish. *Carangus ignobilis*, like *Carangus hippos* of the Atlantic, has the breast naked except for a small central patch. The anal lobe is bright yellow, the pectoral pale. As a food-fish *Carangus forsteri*, the ulua, and *Carangus melampygus*, the malauli, are far superior to all others of this genus in the Pacific. *Caranx latus* (*fallax*) of the Atlantic is a closely related but distinct species. We adopt for the ulua, provisionally, the name of *Caranx forsteri*, as it seems to be the oldest properly applied to the species.

The ulua is the food fish par excellence of the mid-Pacific, both in Samoa and Hawaii. It reaches a large size, similar to that of the malauli, and it is scarcely less common than the atule. Hundreds of specimens were taken in Samoa, and a few preserved.

A specimen from Pago Pago in life had the anal dark, pectoral yellow in the young, growing dull with age; body green, with blue specks, the fins with blue-black luster. Dorsal rays 23 or 24; body deep; preorbital deep; breast scaly; fins high; no opercular spot.

One specimen from Apia in life had the pectoral bright yellow, anal dark; another was pale bluish silvery, the vertical fins all dusky, the pectoral bright yellow, ventral slightly dusky. Eye small; plates small.

423. Caranx marginatus (Gill). Hawaii; Samoa; west coast of Mexico and Panama.

Two species from Samoa seem to be referable to this species. Possibly *Caranx heberi* Bennett, from Ceylon, is the same species.

424. Caranx ignobilis (Forskål). *Lupo.* Samoa; Hawaii; New Guinea (Macleay); East Indies.

(*Carangus hippoides* Jenkins; *Caranx sem, ekala, lessoni, xanthopygus*, etc., Cuvier & Valenciennes.)

Frequently taken about Samoa.

425. Caranx sexfasciatus (Quoy & Gaimard). *Lupo.* Hawaii; Samoa; Vanicolo; Waigiu; Java.

This species, recently described as *C. rhabdotus* Jenkins from Hawaii, is common in the mouths of the streams of Upolu, especially the sluggish stream called Gasegase River, ascending even into the smaller brooks. One specimen was taken by us in salt water, and this has lost the cross bands and some part of the peculiar dusky shade of the others, although even in this the caudal plates are of a watery blackish color. About a dozen specimens were taken. The cross bands, very distinct in the young, grow faint with age.

This species seems to be the one figured by Quoy and Gaimard under the name of *Caranx sexfasciatus*. Jenkins's figure of *Caranx rhabdotus* represents it very fairly, and we are forced to believe that the two are the same species. From *Caranx ignobilis*, which has also the anal fin yellow, *Caranx sexfasciatus* differs in having the breast entirely scaled. In *Caranx ignobilis* the breast is naked, with a small central patch of scales as in *Caranx hippos* of the West Indies. *Caranx forsteri* has more anal rays and more (30 to 33) lateral plates. The mouth is larger in *Caranx sexfasciatus* than in *Caranx forsteri* or any other of the related species. *Caranx forsteri* shows no cross bands at the size (4 to 8 inches) of our specimens of *Caranx sexfasciatus*.

Life colors of a specimen from Gasegase River, at Apia, dark brassy with a transparent blackish wash, as usual in fishes from muddy water; 6 broad darker cross bands; a black opercular spot; no pectoral spot; anal dull yellow, the lobe not sharp; upper fins dark. Another specimen from Apia had the pectoral pale, anal yellow. A specimen from fresh water near Vailele, Upolu, in life had the body barred, an opercular spot, upper fins dusky, lower dull yellow. In a specimen from the swamp at Pago Pago the anal fin was bright yellow, caudal not so.

426. Caranx dasson Jordan & Snyder. Hawaii.

427. Caranx elacate (Jordan & Evermann). Hawaii.

428. Caranx regularis Garman. Fiji.

Caranx regularis Garman, Bull. Mus. Comp. Zool., vol. XXXIX, no. 8, 1903, 232, **Fiji**.

429. Caranx parasitus Garman. Fiji.

Caranx parasitus Garman, Bull. Mus. Comp. Zool. vol. XXXIX, no. 8, 1903, 232, **Fiji**.

430. Caranx boops Cuvier & Valenciennes. New Guinea; Vanicolo; East Indies.

431. Caranx novæ-guineæ Cuvier & Valenciennes. New Guinea.

432. Caranx affinis Rüppell. Hawaii; East Indies.

433. Caranx hasselti (Bleeker). New Guinea (Macleay); Hawaii; East Indies.

(*Carangus politus* Jenkins.)

A specimen of *Carangus hasselti* from Negros in the Philippines agrees in every respect with Jenkins's account of *Carangus politus*.

434. Caranx helvolus (Forster). Tahiti(?); Hawaii.

This species, obtained by Forster on the second cruise of Captain Cook, was rediscovered by Professor Snyder in 1901.

435. Caranx cheilio (Snyder). Hawaii.

436. Caranx papuensis Alleyne & Macleay. New Guinea.

Caranx papuensis Alleyne & Macleay, Proc. Linn. Soc. N. S. W. 1876, 325.

437. Caranx platessa Cuvier & Valenciennes. New Guinea (Alleyne & Macleay); Australia.

(*Caranx georgianus* Cuvier & Valenciennes.)

438. Caranx bucculentus Alleyne & Macleay. New Guinea.

439. Caranx moresbyensis Macleay. New Guinea.

Caranx moresbyensis Macleay, Proc. Linn. Soc. N. S. W. 1883, 358, **Port Moresby (New Guinea)**.

440. Caranx obtusiceps (Macleay). New Guinea.

441. Caranx cheverti Alleyne & Macleay. New Guinea.

442. Caranx laticaudus Alleyne & Macleay. New Guinea.

443. Caranx cæruleopinnatus Cuvier & Valenciennes. New Guinea.

444. Caranx ferdau (Forskål). *Lupo*. Samoa; Hawaii; Tahiti; Bonin Is.; East Indies.

This species is not rare about Hawaii and was frequently taken at Samoa, where it is valued as a food fish.

445. Caranx ajax (Snyder). Hawaii.

446. Caranx gymnostethoides Bleeker. Johnston I., south of Hawaii; East Indies.

447. Caranx speciosus[a] (Forskål). Hawaii; Samoa; New Guinea; Fiji; East Indies; Panama.

Not rare about Hawaii, and occasionally taken at Pago Pago. Life colors of a specimen from Pago Pago, green-golden with green iridescence; black transverse bars on head (through eye), next one blackish; others simply dark, fading posteriorly; caudal with blackish tips and margin.

448. Caranx edentulus Alleyne & Macleay. Percy I., New Guinea.

449. Caranx armatus (Forskål). New Britain; New Guinea (Peters, Alleyne & Macleay); East Indies.

450. Caranx oblongus (Cuvier & Valenciennes). Vanicolo; Oualan; New Britain; Solomon Is.; Sumatra.

This species, as originally described, has the anal rather low, the opercular spot wanting, the plates on the tail about 40. It is not clear that all the above references belong to it, although specimens from Sumatra, recorded by Mr. Fowler as *Citula oblonga*, agree fairly with the original account.

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[a] The genus *Caranx* was originally based on *C. speciosus*, a species without teeth in the adult stage. *Carangus* has small even teeth; *Tricopterus*, larger, unequal teeth, and *Citula*, the dorsal rays produced, the teeth being very small. For the present we place all these species in a single genus *Caranx*, as the subdivisions need better definition.

451. Caranx plumbeus (Quoy & Gaimard). *Lupo; Lupo ta; Lalafutu; Alālafutu.* Ile de France; Samoa.

Head 3.25 in length; depth 2.18; dorsal vi–i, 22; anal ii–i, 18; eye 3 in head; snout 2.75; maxillary 2.18, extending to below anterior margin of eye; 43 plates along straight portion of lateral line, the curved portion a third longer than the straight.

Body oblong, compressed; profile of head gibbous and keeled; anterior dorsal and anal rays elongate (male fishes have 9 and 10 dorsal rays and 7 and 8 anal rays elongate), the first dorsal ray being greater than depth of fish, 2 in length. The first anal ray is 2.75 in length; base of anal about equal to pectoral, which is 2.75 in length of fish; base of dorsal 2.20 in length; caudal deeply forked, the lobes slightly longer than head; ventrals 2 in head; opercle with small rounded nick on upper margin; scales of body small, about 100 in curved portion of lateral line; thorax naked; cheek scaled and upper part of opercle scaled; bands of minute teeth in jaws, vomer, palatines and middle of tongue; a narrow adipose eyelid; preorbital less than width of eye; mouth large, lower jaw slightly the longer; gill-rakers strong, two-thirds length of eye, 16 on lower limb.

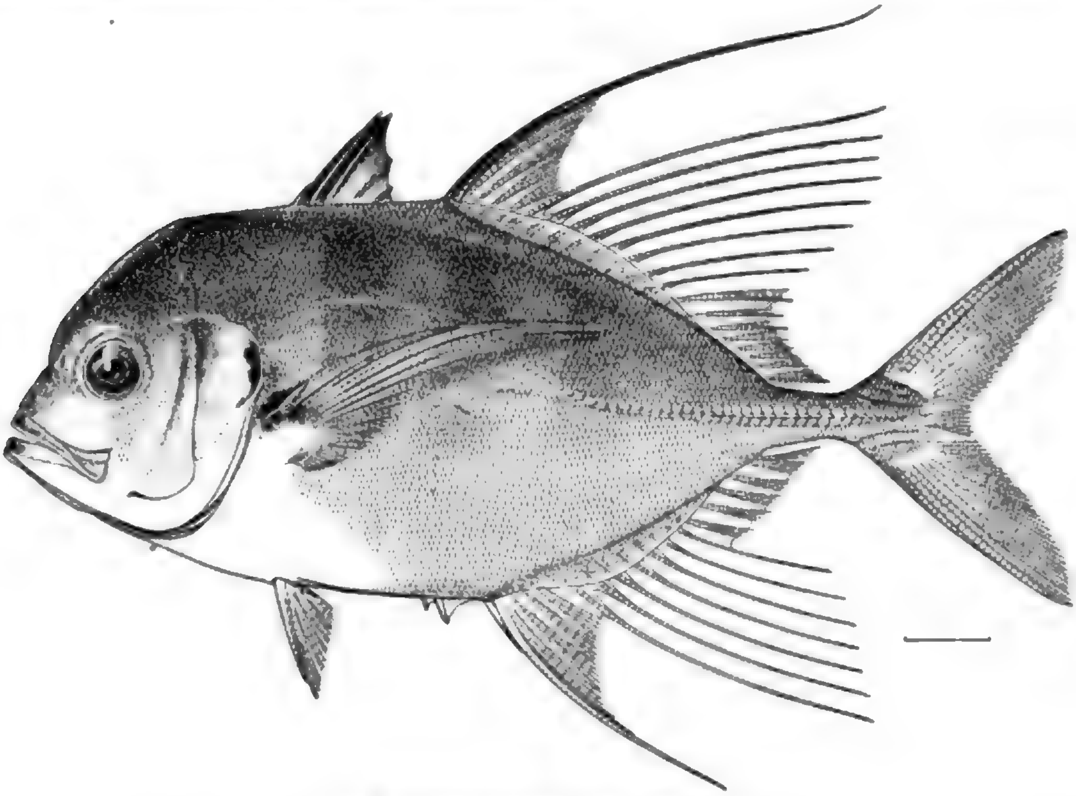

FIG. 28.—*Caranx plumbeus* (Quoy & Gaimard).

Color in spirits silvery bronze, the scales with beautiful iridescence, slightly darker above, some specimens showing slight indications of five or six wide vertical brown bands on upper half of body; a black opercular spot; a large black spot in axil of pectoral, extending on its upper base; cheek more or less blotched with golden; an indistinct dusky blotch on upper part of preopercle between the black opercular spot and eye; spines of dorsal dusky; margin of dorsal and its elongate filaments dusky; caudal with indistinct dusky margin; pectoral, ventral, and anal yellowish white, the anal showing a slight dusky wash on webs.

A specimen from Apia in life was silver-green, bluish below; axil black; opercular spot faint olive; caudal dull yellow; anal and ventral whitish, slightly olive-tinged. Dorsal and anal with one filament only. In others of the same species, males, there are numerous filamentous rays on the dorsal and anal fins.

This species belongs to the subgenus *Citula*. We have 5 specimens, 4 male and 1 female, taken in the seine at Apia and Pago Pago. The description is that of a male 12.50 inches long.

Citula plumbea Quoy & Gaimard from Ile de France, with the fin-rays as in our specimens and the depth nearly 3 in total length, is apparently identical with the species in hand. *Caranx armatus* (Forskål) may be the same, but the body is deeper in some specimens called *Caranx armatus* than in our specimens from Samoa, which we record provisionally as *Caranx plumbeus*. In *Caranx armatus* the depth is 2 to 2.5 in total length.

452. Caranx mandibularis Macleay. New Guinea.

Caranx mandibularis Macleay, Proc. Linn. Soc. N. S. W. 1883, 356, **New Guinea.**

This species belongs to *Citula*, having the first dorsal ray very long.

453. Caranx gilberti Jordan & Seale, new species. Samoa.

Head 3.60 in length; depth 2.20; eye 4 in head, 1.10 in snout; interorbital 2.95 in head; dorsal VI-I, 33; anal II-I, 29; scales minute, 143 on lateral line, 25 of which are modified into plates of moderate size; maxillary 2.50 in head, extending to below anterior margin of eye.

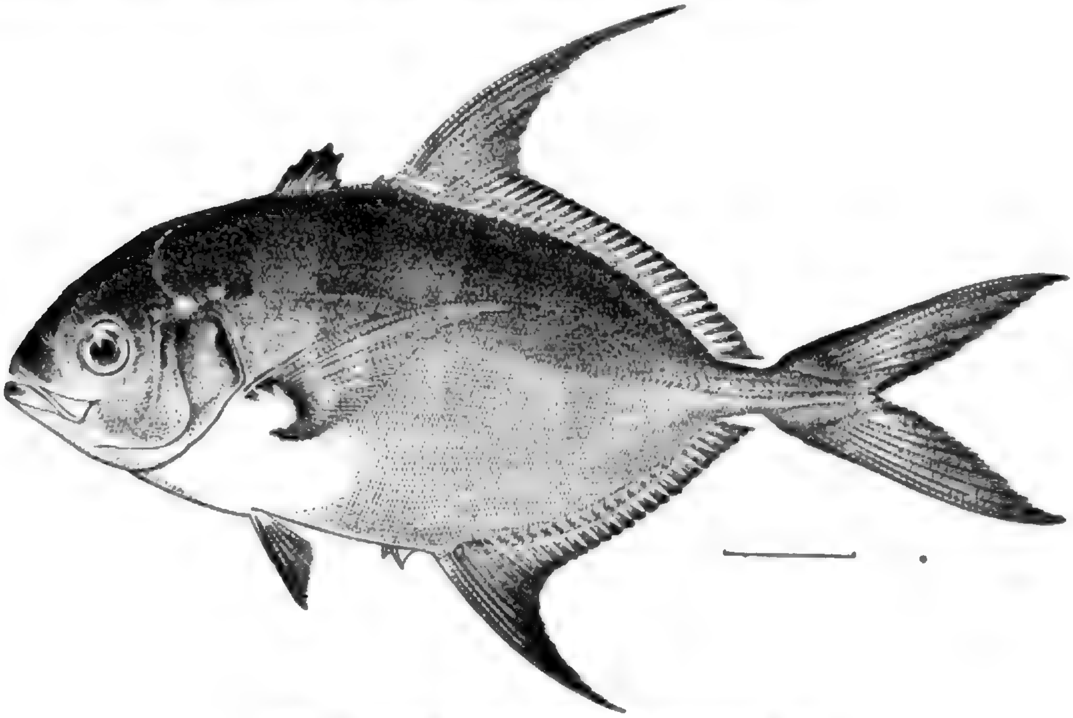

FIG. 29.—*Caranx gilberti* Jordan & Seale, new species. Type.

Body ovate, strongly compressed, shaped as usual in *Caranx*, the upper profile more ovate than lower; anterior lobes of dorsal and anal falcate, elongate and graduated, the anterior ray of dorsal longer than head, 3 in length (without caudal), anterior ray of anal equal to head; base of dorsal slightly greater than anal; pectoral reaching to below straight portion of lateral line, its length equal to base of anal, 2.75 in length of fish without caudal; length of caudal slightly less than pectoral; ventrals 2 in head; teeth in villiform bands on vomer, palatine, and tongue; jaws with patches of minute teeth in front and a single series on side, no enlarged outer teeth; gillrakers less than width of eye, 14 on lower limb; preopercle entire; opercle with slight rounded nick above; eye with adipose membrane slightly developed; head and body scaled, except thorax, which is naked; dorsal and anal enveloped in rather high shields.

Color in spirits, silvery with slight brassy tint, darker above; dorsal, anal, and caudal with slight dusky wash. There is a narrow black margin to caudal and a black line on margin of dorsal; pectoral and ventral yellowish white.

One specimen, type no. 51729, U. S. National Museum, from Pago Pago, island of Tutuila, length 8.50 inches.

ALECTIS Rafinesque.

454. Alectis ciliaris (Bloch). Hawaii; Samoa; New Ireland (Peters); Tahiti; Palau Is.; Kingsmill I.; New Guinea; Solomon Is.

Of this widely distributed species, we have several small specimens from Apia.

TRACHINOTUS Lacépède.

455. Trachinotus ovatus (Linnæus). *Alālafutu.* Samoa; New Hebrides; New Guinea (Macleay).

Of this widely diffused species, we have three examples from Apia, one very large, nearly 2 feet in length. Life colors of one of these specimens gray, back tinged with creamy bronze; dorsal dark, the lobe largely covered with creamy bronze; ventral, anal, belly, and lips still more orange; tail black. Specimen from Pago Pago, lobes of dorsal, anal, and caudal black, washed with creamy orange; ventral and anal lobe largely orange.

456. Trachinotus bailloni Lacépède. Samoa (Günther); New Hebrides; Tahiti; New Britain (Peters); New Guinea (Macleay).

This species, recorded from Samoa with the preceding, was not taken by us.

457. Trachinotus russelli Cuvier & Valenciennes. New Guinea; East Indies.

Trachynotus coppingeri Günther, Zool. Alert, 1884, 29, Percy I. (New Guinea), in Cloudy Bay.

Family CORYPHÆNIDÆ.

CORYPHÆNA Linnæus.

458. Coryphæna hippurus Linnæus. Hawaii; warm seas.

459. Coryphæna equisetis Linnæus. Between Tahiti and Hawaii; warm seas.

Family BRAMIDÆ.

TARACTES Lowe.

460. Taractes orcini (Cuvier & Valenciennes). South seas; Indian Ocean.

COLLYBUS Snyder.

461. Collybus drachme Snyder. Off Hawaii.

Family PSENIDÆ.

PSENES Cuvier.

462. Psenes javanicus Cuvier & Valenciennes. Guam; East Indies.

(*Psenes guamensis* Günther.)

CUBICEPS Lowe.

463. Cubiceps pauciradiatus Günther. Misol.

Cubiceps pauciradiatus Günther, Ann. Mag. Nat. Hist. 1872, 423, Misol. Regan, Ann. Mag. Nat. Hist. 1902, 123.

ARIOMMA Jordan & Evermann.

464. Ariomma lurida Jordan & Evermann. Hawaii.

465. Ariomma evermanni Jordan & Snyder. Hawaii.

Family ICOSTEIDÆ.

SCHEDOPHILUS Cuvier.

466. **Schedophilus medusophagus** Cocco. Off Samoa (Günther).

Family STROMATEIDÆ.

LEIRUS Lowe.

467. **Leirus maculatus** (Günther). South Seas.

468. **Leirus paucidens** Günther. Between New Guinea and Japan.

Lirus paucidens Günther, Pelagic Fishes Challenger, 1888, 11, **open sea north of New Guinea.**

Family RACHYCENTRIDÆ.

RACHYCENTRON Kaup. (*Elacate* Cuvier.)

469. **Rachycentron pondicerrianum** Cuvier & Valenciennes. Vanicolo; East Indies.

Family ANOMALOPIDÆ.

ANOMALOPS Kner. (*Heterophthalmus* Bleeker.)

470. **Anomalops palpebratus** Kner. Fiji; Paumotu Is.; Celebes.

Family PEMPHERIDÆ.

PEMPHERIS Cuvier.

471. **Pempheris oualensis** Cuvier & Valenciennes. *Manifi; Fo a'ao.* Oualan, or Strong Island; Tahiti; Guam; Vanicolo; Samoa; Kingsmill I.; Caroline Is.; New Guinea (Macleay).

Pempheris oualensis Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 299, 1831, **Oualan.**

Pempheris otaitensis Cuvier & Valenciennes, op cit., VII, 304, 1831, **Tahiti.** Günther, Cat., II, 508, China, Amboyna. Kner, Novara Fische, 171, Java. Günther, Fische der Südsee, 102. Seale, Bishop Museum 1901, 74, Guam. Sauvage, Poiss. Madagascar, 286, Tahiti.

Pempheris mangula Günther, Fische der Südsee, 102, taf. 59, fig. B, **Samoa, Vanicolo, Kingsmill I., Caroline Is., Tahiti**; not of Cuvier & Valenciennes.

Of this species, sharply distinguished by the presence of a large black spot on the base of the pectoral, we have about a dozen fine specimens from Samoa. Life colors of a specimen from Apia, dirty olive, sides silvery; dorsal dirty olive, its anterior rays black; caudal pale within, the outer rays dirty dull red; anal gray, its base blackish; pectoral reddish, the anterior rays quite red, its base jet black; ventral gray; axil jet black; body with some violet luster.

472. **Pempheris vanicolensis** Cuvier & Valenciennes. *Pula.* Vanicolo; Samoa; Ile de France.

Pempheris vanicolensis Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 305, 1831. **Vanicolo.**

Pempheris neogallica Cuvier & Valenciennes, op. cit., VII, 306, 1831, **Ile de France.**

Three specimens taken in the seine at Apia. This species is well distinguished by the entire absence of black on the base of the pectoral. Depth 2.2 in length. We see no reason for supposing this species to be identical with the Indian species *Pempheris mangula.*

Life colors of a specimen from Apia, coppery black; dorsal and anal pale, the lobes tipped with jet black; pectoral golden; ventral orange, blackish at base; no spot at base of pectoral.

Family SCORPIDÆ.

MONODACTYLUS Lacépède.

Monodactylus Lacépède, Hist. Nat. Poiss., III, 131, 1802 (*falciformis*).
Centropodus Lacépède, op. cit., III, 303, 1802 (*rhombeus*=*argenteus*).
Acanthopodus Lacépède, op. cit., IV, 558, 1803 (*argenteus*).
Psettus Cuvier (argenteus).

This genus is distinguished from *Psettias* Jordan, new genus (*seba*) by the rounded outline of the body, which is not deeper than long. In *Psettias* it is very much deeper than long.

473. **Monodactylus argenteus** (Linnæus). *Toto.* Samoa; New Guinea; Vanicolo; Fiji; East Indies; Australia.

Chætodon argenteus Linnæus, Syst. Nat., ed. x, 1758, **China**; after Lagerstrom. Günther, Cat., II, 488, Moluccas, Amboina, Ceylon, Australia.
Psettus argenteus, Günther, Fische der Südsee, 140, Samoa. Klunzinger, Fische Roth. Meeres, 794, Red Sea.
Scomber rhombeus, Forskål, Descrip. Anim., 58, 1775, Red Sea.
Monodactylus falciformis Lacépède, Hist. Nat. Poiss., III, 131, 1802.
Psettus commersoni Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 250, 1831, **Vanicolo; after Lacépède.**

This species, common in the East Indies, was found rather abundant in the harbor of Apia in the deeper water between the reefs. Eight specimens were taken. It is a valued food-fish.

Life colors of a specimen from Apia, silvery white with some dusky; a faint orbital bar. Young with three curved black cross bars on the head.

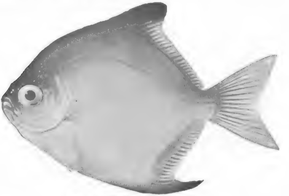

FIG. 30.—*Monodactylus argenteus* (Linnæus).

ATYPICHTHYS Günther.

474. **Atypichthys strigatus** (Günther). Erromango, New Hebrides; Palacky; Australia.

Family KURTIDÆ.

KURTUS Bloch.

475. **Kurtus gulliveri** Castelnau. New Guinea.

Kurtus gulliveri Castelnau, Proc. Nat. Hist. Soc. Victoria, **New Guinea.**
Cyrtus gulliveri, Ramsay & Ogilby, Proc. Linn. Soc. N. S. W., 1886, 10, Strickland River (New Guinea).

Family APOGONICHTHYIDÆ.

AMIA Gronow[a] (1763). (*Apogon* Lacépède, 1802.) *Fo.*

476. **Amia snyderi** (Jordan & Evermann). Hawaii; Samoa; Tahiti; Paumotu Is.; Tubuai; Faté, Shortland I., and Raiatea (Seale).

Apogon snyderi Jordan & Evermann, Bull. U. S. Fish Comm., XXII, 1902 (1903), 180, **Honolulu.**
Apogon frenatus Günther, Fische der Südsee, I, 19, taf. 19, fig. A, 1873, Hawaiian, Society, and Paumotu Is. Steindachner, Denks. Ak. Wis. Wien, LXX, 1900, 484, Honolulu. Not *Apogon frenatus* Valenciennes, Nouv. Ann. Mus. Nat. Hist., 1832, 57, pl. 4, fig. 4, nor of Klunzinger.

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[a] Under the rules of nomenclature adopted by us the name *Amia* Gronow (1763) becomes tenable for this genus, having priority over *Apogon* (1802) and over *Amia* Linnæus (1766), for which genus Rafinesque's name, *Amiatus* (1815), must be used.

This large species is very common about the Samoan Islands, as also about Hawaii. We have about 40 specimens from Apia and Pago Pago. The dark spot at base of caudal above is usually distinct, though varying much in degree of definition. There is a more or less evident lateral shade, but never sharply defined.

Life colors of a specimen from Apia, brownish red; sides washed with clear light green, the edges of scales brownish red; a diffuse black bar at base of caudal, forming a pretty distinct rounded spot above lateral line and extending backward on edges of both caudal lobes; a faint dark shade from snout across eye, with a darker blotch on opercle and a rounded spot behind eye; a dusky shade on side from eye to tail on larger specimens; axil dull reddish brown; fins all dull reddish brown; first dorsal black on anterior spines; second dorsal and ventral dusky shaded.

477. Amia frenata (Valenciennes). New Guinea; Guam.

Apogon frenatus Valenciennes, Nouv. Ann. Hist. Nat., I, 57, 1832, with plate. **New Guinea, Guam.**

This species we have failed to recognize. It is close to our *Amia exostigma*, differing in the narrower lateral band, and in the more diffuse caudal spot, which is at the end of the lateral band. It is more remote from *Amia snyderi*, which has the lateral stripe fainter, broader, and more diffuse.

478. Amia exostigma Jordan & Starks, new species. Samoa.

Head 2.75 in length; depth 3.3; eye 3 in head; interorbital width 5; snout 3.75; maxillary 2.25; caudal peduncle 2.67; dorsal VII-I, 9; anal II, 9; scales 2-25-5.5.

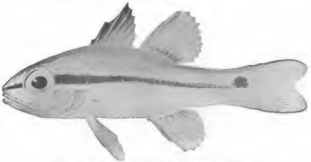

FIG. 31.—*Amia exostigma* Jordan & Starks, new species. Type.

Body slender; upper anterior profile a slight, even, unbroken curve from tip of snout to first dorsal spine; snout blunt, and projecting very slightly beyond the maxillary; maxillary extending to below middle of eye, its anterior end projecting a very little beyond tip of lower jaw; teeth in moderately wide bands on jaws, in a narrower V-shaped patch on vomer; rather large spines on both posterior edges of preopercle, those near the angle larger, all of them directed backward; gillrakers rather slender, the longest one-third the diameter of the eye, 4 + 14 in number, about 4 of which are represented by tubercles on the anterior end of the lower limb.

Scales everywhere ctenoid, the marginal denticulations fine and close-set, preceded by many short spinules regularly placed, forming a moderately wide band around the posterior border of each scale. Third dorsal spine longest, its length equal to distance between tip of snout and posterior margin of pupil; when fin is depressed its tip reaches a little past front of soft dorsal; first spine very short, 5 in eye; the second spine midway between these two spines in length; second dorsal with a long spine equal in length to the second dorsal base; second dorsal ray the longer, equal to length of head anterior to anterior preopercle margin; second anal spine a little longer than diameter of eye; anal placed a little posterior to soft dorsal; ventrals scarcely reaching to front of anal; pectoral reaching to above base of second anal spine.

Color in life of a specimen from Pago Pago, light olive; jet black band from snout through eye, fading behind; just above this stripe at base of caudal a round, jet black spot as large as pupil; fins dull reddish; first dorsal spine black; a dark streak on base of dorsal and anal and upper and lower caudal lobes; cheek and breast soiled silver.

Color in alcohol, slightly dusky with fine dots; scarcely darker on back; a black lateral band from tip of snout across eye, but not involving eye, tapering backward to base of middle caudal rays; widest just behind eye; a conspicuous round black spot on caudal peduncle at base of caudal rays, just above lateral line; a short light stripe with violet reflections on opercle bordering black lateral stripe, below which opercle is silvery with violet reflections; upper and lower margins of caudal bordered with black; dusky shades at base of soft dorsal and anal.

Eight specimens from Apia and Pago Pago. This species is very close to *Amia frenata* and *A. melanorhynchus*, differing in having the very distinct caudal spot above the termination of the jet black lateral band and entirely separated from it, the band growing very faint before reaching the base of the caudal.

The lateral band is in this species very broad anteriorly, almost as broad as the eye, while in *Amia frenata* this band is narrow. In *Amia snyderi*, also a closely related species, the lateral band and its terminal spot are broad and diffuse.

The type is from Apia; it is 3 inches in length, and is no. 51732, U. S. National Museum.

479. Amia menesema (Jenkins). Hawaii.

480. Amia crassiceps (Garman). Fiji; Samoa.

Apogon crassiceps Garman, Bull. Mus. Comp. Zool., 1903, **Suva (Fiji).**

One large specimen taken at Apia.

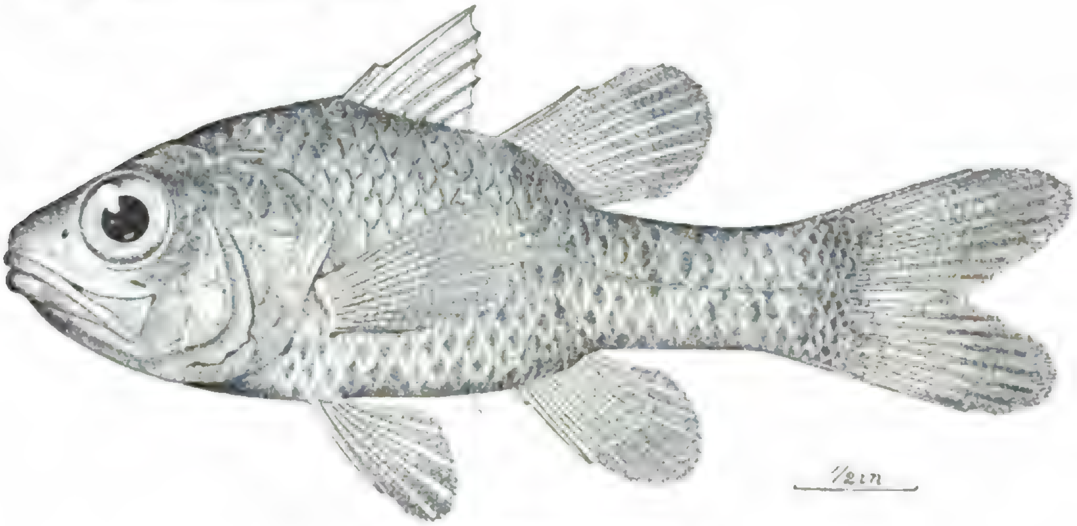

FIG. 32.—*Amia crassiceps* (Garman).

481. Amia evermanni (Jordan & Snyder). Hawaii.

482. Amia orbicularis (Cuvier & Valenciennes). Radack I.; East Indies.

483. Amia guamensis (Valenciennes). Guam.

Apogon guamensis Valenciennes, Ann. Mus. Nat. Hist., I, 55, 1831, **Guam.**

A deep-bodied, plain-colored species with large head and one limb only of the opercle serrate; caudal notched. This species may be the same as *A. crassiceps*.

484. Amia savayensis (Günther). Savaii, Samoa; Tonga; Yap; Tahiti; Fiji; Faté; Shortland I. and Raiatea (Seale); East Indies.

Apogon savayensis Günther, Proc. Zool. Soc. 1871, 656, **Savaii (Samoa).** Günther, Fische der Südsee, 21, taf. 19, fig. B, Samoa, Tonga, Yap, Tahiti, Celebes. Seale, Bishop Mus. 1901, Fishes Guam, 76, Guam.
Apogon bandanensis Steindachner; not of Bleeker, who has wrongly identified *savayensis* with *bandanensis*.
Apogon fuscus Günther, Fische der Südsee, 22, Fiji.
Apogon nubilus Garman, Bull. Mus. Comp. Zool., 1903, **Suva (Fiji).**

This species is very common about the Samoan Islands. We have about 100 specimens from Apia and Pago Pago. Ordinarily the color markings are very distinct. There is an oblique black streak backward and downward from eye; about eight vertical silvery stripes on the side between pectoral and region above middle of anal; a blackish saddle on caudal peduncle, and a black and white stripe on each edge of caudal. In some specimens, however, any or all of these marks may be reduced to mere traces. The silvery cross-streaks, the most characteristic of these traits, were wanting in Günther's types. Apparently the specimen called by Günther *Apogon fuscus* was one in which all the marks were obliterated. It is certain that this is not the *fuscus* of Quoy and Gaimard, which has the caudal rounded and blotched with black. Bleeker is certainly wrong in regarding *savayensis* as the same as *Amia bandanensis*. Garman's *Apogon nubilus* is apparently the young of this species with the markings faded, although more distinct than in Günther's type.

Color in life of a specimen from Pago Pago,, dusky olive, with seven narrow dull silvery cross-streaks, each dark-edged on each side; other fainter streaks curved behind; a dusky saddle on caudal peduncle, another under soft dorsal; fins dull red, first dorsal anteriorly black; a dark streak along each caudal lobe; a dusky streak behind eye.

A specimen from Apia in life was brownish olive; side with seven pinkish-white cross-streaks, each edged with brown; an oblique brownish olive bar below eye; a jet black saddle on back of tail; first dorsal blackish; other fins light brownish red; a black streak edged with orange down each lobe of the caudal; tips of soft dorsal and anal light orange-red.

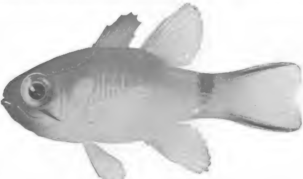

FIG. 33.—*Amia savayensis* (Günther).

The life colors of a young example from Apia were dull olive, faintly barred with paler, a large black spot before base of caudal; no other markings; first dorsal black; other fins pale grayish. Called *fo* by the Samoans.

Another specimen from Pago Pago in life was dull olive, slightly reddish, with some silvery on sides, arranged in cross-bands along muscles; a dark streak like a pencil mark across opercle, another downward and backward from eye; a faint diffuse dark blotch above lateral line from base of caudal, then joined saddlewise over back; first dorsal dusky; other fins purplish olive, the spine of second dorsal dusky. Caudal lunate; dorsal vii; preopercle serrate.

485. Amia koilomatodon (Bleeker). Samoa; Shortland I.; Solomon Is. (Seale); East Indies.

Head 2.60 in length; depth equal to head; eye 3.10 in head; dorsal vi–i, 10; anal ii, 8; scales 2–28–6; interorbital 1.50 in eye; snout 1.20 in eye.

Body oblong, compressed, slightly elevated; caudal peduncle rather thick and strong, its depth 1.50 in length, which is equal to distance from anterior margin of eye to posterior margin of opercle; mouth large; maxillary equal to post-ocular portion of head; its distal end under posterior margin of pupil, the width of distal end slightly greater than pupil; villiform teeth on jaws, vomer, and palatine;

the two limbs of preopercle distinctly denticulate; the lower posterior limb of preorbital denticulate; gillrakers rather sharp pointed, the longest scarcely equal to pupil, 17 on lower limb; second dorsal spine much the strongest, its length 2 in head; base of soft dorsal 3 in head, its longest ray 1.80 in head; anal rounded, its base 2 in its length, the second spine 2.25 in head, its longest ray 1.75 in head; pectoral 1.45 in head, its distal end below middle of soft dorsal; ventrals reaching base of anal, their origin directly below origin of pectoral; caudal bilobed, 1.50 in head.

Color in spirits, light brownish; a black half-band at origin of spinous dorsal extending to beneath anterior third of pectoral; a second black band at origin of soft dorsal, extending down to lateral line; a third black band at posterior axil of soft dorsal, longer than second band, extending to below lateral line, in young examples extending to middle of anal base; a third very indistinct dark band over middle of caudal peduncle (in an old example this is broken up into three or four round spots); a distinct round spot on lateral line just anterior to base of caudal; a round black spot on opercle; a distinct black line from eye to angle of preopercle; anterior dorsal spine black, upper and lower margin of caudal dusky; tip of ventral and anal with dusky wash; pectoral yellow.

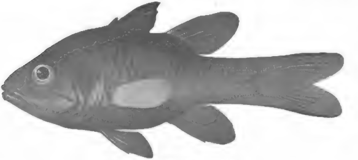

FIG. 31.—*Amia koilomatodon* (Bleeker).

Color in life of a very large specimen from Pago Pago, dark reddish olive brown; a faint darker bar under first dorsal, one under second dorsal; a small round blackish spot at base of caudal, and one on opercle before its edge; iris golden. Fins all dusky brownish red, the first dorsal darker; dorsal rather dark; dark dots confluent along base of soft dorsal. Caudal lunate; dorsal VI.

Another large specimen from Pago Pago was dark olive brown in life, much mottled, with three vague dark cross-bands; a large black spot on opercle and another at base of caudal; fins mottled brown.

We have eight specimens from Apia and Pago Pago, of a large and robust species of *Amia*, evidently allied to *Amia koilomatodon*. It has a distinct caudal spot, which is said to be wanting in the latter, but as no other differences appear, we refer our specimens provisionally to *Amia koilomatodon*. The specimen described is no. 51733, U. S. National Museum, 5.63 inches long.

486. Amia nigripinnis (Cuvier & Valenciennes). Bonham I.; East Indies.

487. Amia maculifera (Garrett). Hawaii.

488. Amia novæ-guineæ (Valenciennes). Papua; East Indies.

489. Amia aroubiensis (Hombron & Jacquinot). Samoa; Tahiti; Tubuai; Shortland I.; Nukahiva (Seale).

Apogon aroubiensis Hombron & Jacquinot, Voy. au Pole Sud, Poiss., 31, pl. 1, fig. 1. **Aroub in Malaysia.**
Apogon fasciatus Günther, Fische der Südsee, 19, taf. 20, fig. A.

This species very closely resembles *Amia novemfasciata*, but the colors are deeper, and the black bands, broader and continuous, do not extend on the caudal fin. There is no black spot on base of pectoral. It is certainly a distinct species, and it is fairly represented by Dr. Günther's figure A, as well as apparently in the poor plate of Hombron and Jacquinot.

About 10 specimens from Apia and Pago Pago. Color in life of a specimen from Apia, reddish gray, with five stripes of very deep red-black, the interspaces gray; iris gray with yellowish tinge; fins all pale red; an oblique streak on each dorsal and on anal; none on caudal, the bands not converging on the fin.

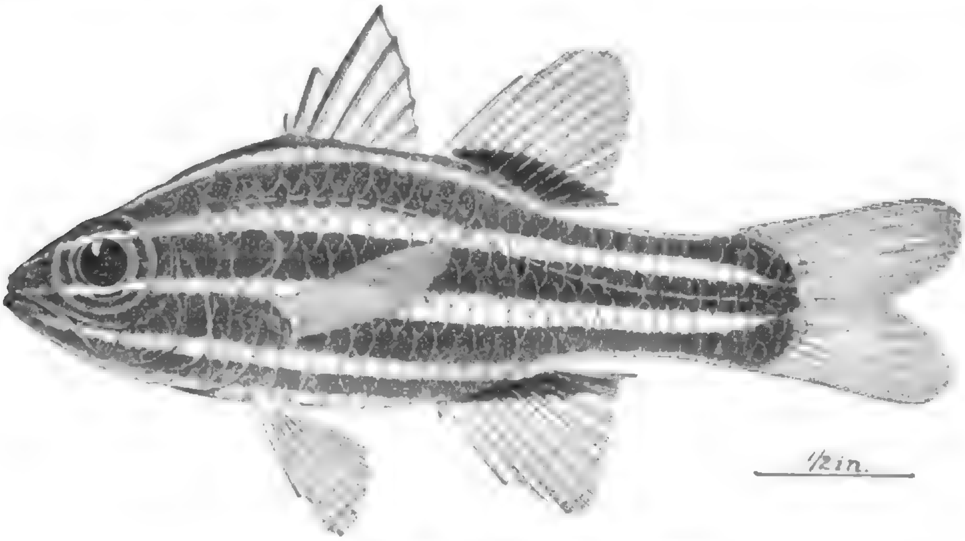

FIG. 35.—*Amia aroubiensis* (Hombron & Jacquinot).

490. Amia novemfasciata (Cuvier & Valenciennes). Samoa; Guam; Tahiti; Kingsmill I.; Faté (Seale); East Indies.

Apogon novemfasciatus Cuvier & Valenciennes, Hist. Nat. Poiss., II, 154, **Timor and Guam.**

Apogon fasciatus Quoy & Gaimard, Voy. Uranie, 344, **Guam.** Günther, Fische der Sudsee, 19, taf. 20, fig. B, Society, Samoan, and Kingsmill islands, etc.; not fig. A. Bleeker, Atlas, tab. XLVIII, fig. 4, East Indies. Streets, Bull. U. S. Nat. Mus., VII, 100, 1877, Samoa. Seale, Bishop Mus. 1901, 76, Guam; not of White.

Head 2.50 in length; depth 2.85; eye 3.20 in head; snout 4 in head; dorsal VII–I, 9; anal II, 8; scales 2–28–6; interorbital 2 in orbit.

Body oblong, compressed; caudal peduncle strong, its depth 1.50 in its length, which is 1.35 in head; mouth large, jaws equal, maxillary 2 in head, its distal end under posterior third of eye; bands of small teeth on jaws, vomer, and palatines; gillrakers not very sharp, the longest equal to width of pupil, 14 on lower limb (12 developed); opercle entire; outer limb only of preopercle denticulate; base of spinous dorsal 1.40 in the third spine, which is the longest and strongest; base of soft dorsal 2.75 in head, its longest ray equal to distance from middle of eye to posterior tip of opercle; base of anal equal to orbit, its longest ray 1.75 in head; pectoral 1.50 in head, its distal end reaching to base of soft dorsal; ventrals 1.40 in head, their insertion directly below base of pectoral, their tips scarcely reaching base of anal fin; caudal emarginate, 1.30 in head.

Color in spirits, yellowish white, with four brown longitudinal bands about as wide as interspaces, the first extending from middle of interorbital, dividing in front of dorsal fin into two which continue along base of dorsal, uniting behind in a single line along top of caudal peduncle; the 2nd band extending from upper margin of orbit to caudal, where it runs obliquely out on fin to join the end of the third line, which extends from tip of snout through eye to tip of caudal fin; the fourth line extending from side of snout along lower part of orbit, over base of pectoral to caudal, where it extends obliquely out on the fin to join the third line at tip—three of the bands thus converging on the caudal fin, each of these bands more or less distinctly widened at about three intervals. There is also an indistinct dusky line from angle of mouth to base of ventrals; a narrow white line along side of snout; two larger dark blotches are apparent on the third body band; base and axil of pectoral dusky; a black line with a narrow light one above it through lower base of soft dorsal; a slight wash of dusky on anterior membrane of spinous dorsal, usually a narrow black line through lower part of anal, disappearing with age.

Color in life of a specimen from Apia, olivaceous, the bands black, converging on caudal; spaces anteriorly before pectoral silvery white, with bright luster; the streaks on head above very white; fins all brick-red.

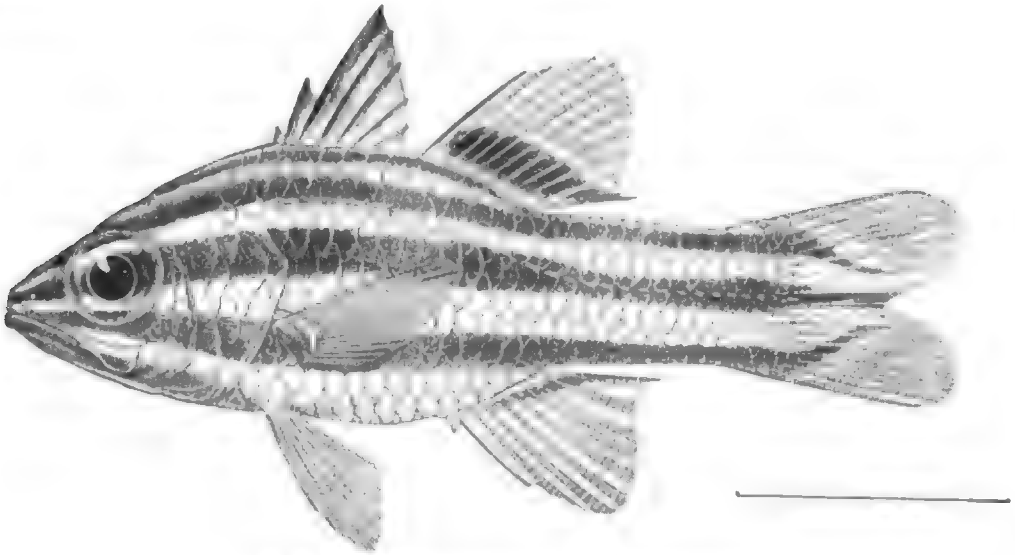

FIG. 36.—*Amia novemfasciata* (Cuvier & Valenciennes).

Another specimen has the stripes darker olive, almost black, on whiter ground; a black bar across axil, and a black spot in front of it; a stripe from angle of mouth to ventrals; fins all pale red, in younger individuals orange yellow; no black marks, except dusky streak at base of second dorsal and anal, which runs obliquely up and back; black bands convergent on caudal, the outer margin pale; first dorsal all pale.

A third specimen from the same locality has a deeper body, the black stripes more olive, none below level of pectoral; no black bar across axil; a blackish spot on lower part of opercle; fins dull red; both dorsals and anal with an oblique black cross-band; stripes on caudal less distinctly converging, the outer margin black; first dorsal all black. These specimens differ rather markedly from the ordinary ones and may represent a distinct species, but, except in color, we find no tangible characters.

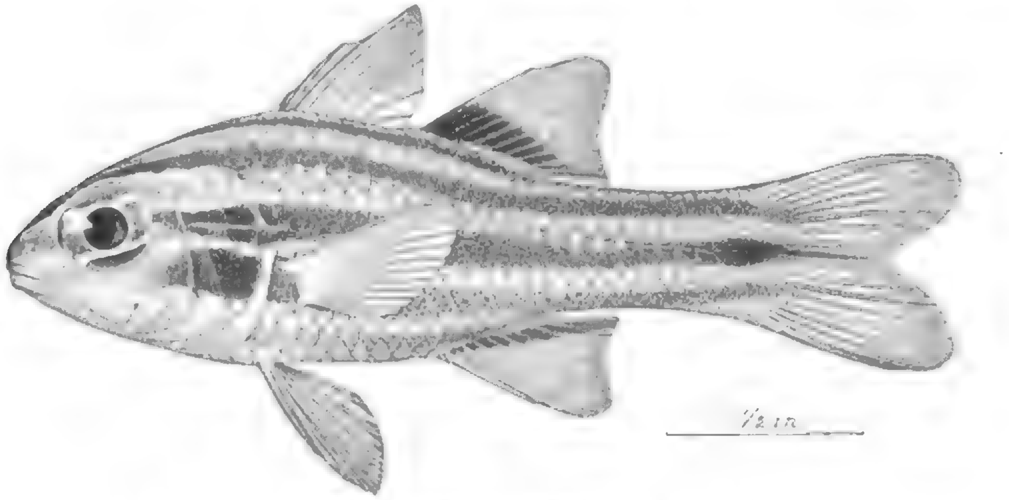

FIG. 37.—*Amia novemfasciata* (Cuvier & Valenciennes). A color variation.

This species is very abundant at Pago Pago and Apia, and we have about 100 specimens. Length 3.25 inches. We have not seen the plate of *Mullus fasciatus*, published by John White. From the account of Cuvier and Valenciennes this species, like *quadrifasciata*, has but two black stripes on each side. The present species, *Apogon fasciatus* of most authors, has five (or four) stripes on each side, two of them converging to meet the middle stripe on the caudal fin. These stripes are relatively narrow, and are again narrowed in two or three places. A black spot at the base of the pectoral is also very constant.

Concerning the types of *Apogon novemfasciatus*, Dr. Léon Vaillant writes:

> Je viens d' examiner les deux *specimens* qu'on peut regarder comme types primitifs de Cuvier et Valenciennes; Ce sont deux individus isolés, l' un rapporté de Timor par Péron, l' autre de Guam par Quoy et Gaimard.
>
> Le premier est un petit exemplaire, long de 40 + 12 = 52 mm en mediocre etat, en grand partie decolore; tout ce qu' on peut dire, c'est que les bandes laterales se voient sur la partie basilaire de la caudale (No. 5646).
>
> L' etat du second est plus satisfaisant. La longueur est de 40 + 12 = 52 mm. Les trois lignes sombres laterales, se prolongent visiblement sur la caudale, la superieure, et l' inferieur convergeant nettement, l' une vers l' autre en arriere (No. 835).

The second of these specimens evidently corresponds to the *Amia novemfasciata* of the present paper, and the other, which is properly the type of *novemfasciatus*, is almost certainly a discolored example of the same species, as the black spots are seen on the base of the caudal fin. In *Apogon amboinensis* of Hombron and Jacquinot the black spots do not encroach on the caudal fin at all.

491. Amia amboinensis (Bleeker). New Guinea (Macleay); Shortland I. (Seale); East Indies.

492. Amia sangiensis (Bleeker). Fiji (Günther); New Guinea (Macleay); Yap (Günther); East Indies.

493. Amia fleurieu (Lacépède). New Guinea (Macleay); East Indies

(*Ostorhinchus fleurieu* Lacépède; *Centropomus aureus* Lacépède; *Apogon annularis* Ruppell; *Apogon roseipinnis* Cuvier & Valenciennes.)

494. Amia tænioptera (Bennett). New Guinea (Macleay); East Indies.

495. Amia buruensis (Bleeker). Normanby I.; New Guinea (Macleay)

496. Amia trimaculata (Cuvier & Valenciennes). New Guinea; East Indies.

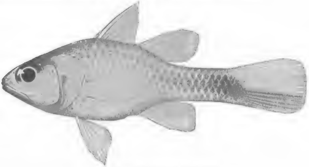

Fig. 38.—*Amia fusca* (Quoy & Gaimard).

497. Amia fusca (Quoy & Gaimard). Samoa.

Apogon fuscus Quoy & Gaimard, Voy. Uranie, Zool., 345, 1824, Guam.

Head 2.85 in length; depth 3; eye 2.75 in head; snout 4.80; dorsal VI-I, 8; anal II, 8; scales 2-23-6; interorbital equal to snout.

Body oblong, compressed, head and body scaled; caudal peduncle long, 3.10 in length of fish, its depth 2.55 in head; jaws even; maxillary 1.95 in head, its distal end under posterior margin of pupil;

bands of villiform teeth on jaws, vomer, and palatines; gill-rakers sharp pointed, the longest less than width of pupil, 14 on lower limb; posterior margin of opercle ending in a spine-like point which extends as a small bony stay across opercle; the posterior limb of preopercle only is serrated; lateral line evenly curved from its origin to a line with posterior axil of dorsal, the straight portion 1.50 incurved. Base of spinous dorsal 1.50 in its height, the second (upright) spine being the longest and strongest; base of soft dorsal 1.95 in its length, the soft dorsal spine being equal to base of fin, 2.90 in head; base of anal equal to depth of caudal peduncle, its longest ray 1.95 in head; ventrals scarcely reaching base of anal, equal in length to distance from middle of eye to posterior tip of opercle, their insertion being slightly in advance of pectoral; pectoral 1.50 in head, the tip on a line with middle of soft dorsal; caudal rounded, 1.20 in head.

Color in spirits yellowish white, thickly covered with minute dots; a broad black area covering most of the caudal peduncle, except its upper and lower sides, this black marking extending out and covering the lower half of the caudal fin; anteriorly this color fades out under the posterior axil of soft dorsal; there is a dusky wash on upper half of eye and on dorsal surface of head; cheek punctulate with brown dots rather larger than those of body, a small brown spot on opercle near base of the bony stay; sides of thorax rather strongly shaded with brown dots; fins yellowish white. The black color of the lower half of the caudal, which fin is not forked, is very distinctive.

One specimen from Apia, length 1.75 inches.

498. Amia zosterophora (Bleeker). New Guinea (Macleay); East Indies.

499. Amia leptacantha (Bleeker). New Guinea (Macleay); East Indies.

500. Amia nematophora (Bleeker). New Guinea (Macleay); East Indies.

501. Amia cookii (Macleay). New Guinea.

Apogon cookii Macleay, Proc. Linn. Soc. N. S. W., v, 1884, 324, **New Guinea.**

502. Amia hyalosoma (Bleeker). Puinepet I.; East Indies.

503. Amia erythrina (Snyder). Hawaii; Samoa.

Of this small species we have seven examples from Apia and Pago Pago. It is clear red in life, often with scattered paler spots, and some dark shading. Our specimens agree well with those from Hawaii.

A specimen from Pago Pago in life was all deep vermilion red. One from Apia was all bright red, a dusky blotch on opercle, dusky shades along base of first dorsal and on top of head; no markings.

504. Amia doryssa Jordan & Seale, new species. Samoa.

Apogon hypselonotus, Günther, Fische der Südsee, 20, South Seas; not of Bleeker.

Head 2.60 in length; depth 2.95; eye 2.85; dorsal VI-I, 9; anal II, 8; scales 2-26-6; interorbital equal to snout.

Body oblong, compressed, its greatest depth at origin of dorsal; body and head scaled; caudal peduncle long, 1.20 in head, its depth 2.95; jaws about even, the under one scarcely as long as upper; maxillary 1.95 in head, its distal end under posterior margin of pupil; bands of minute villiform teeth on jaws, vomer and palatines; gillrakers sharp pointed, 12 on lower limb, the longest less than pupil; opercle with three small spine-like projections on posterior margin; both limbs of preopercle with small denticulations; anterior part of lateral line with strong oblique curve under base of soft dorsal; second (upright) spine of dorsal very strong, flat, and sabre-like, its length equal to distance from anterior margin of eye to posterior margin of opercle; shape of the spinous dorsal that of an acute triangle, the base of which is 1.75 in its length; base of soft dorsal equal to orbit; the spine of soft dorsal slightly longer than base of fin, the fin rounded, its longest ray equal to distance from middle of eye to posterior margin of opercle; base of anal 1.50 in length of longest ray; ventrals below base of pectoral, their length 1.50 in head, their tips reaching to base of anal; pectoral 1.40 in head, extending to a line with sixth anal ray; caudal bilobed, the longest ray equal to distance from anterior margin of orbit to posterior edge of opercle.

Color in life, light brick-red, fins a little darker; no trace of markings. Color in spirits, yellowish white, some black shading at base of spinous dorsal; a few small dusky blotches on upper part of opercle; fins without markings.

Three specimens from Apia. The type is no. 51812, U. S. National Museum; length 1.87 inches.

Dr. Günther identifies his specimens, apparently similar, with *Apogon hypselonotus*, but Dr. Bleeker is apparently correct in regarding the species of the South Seas as distinct. The species resembles *Amia erythrina*, but the dorsal spines are stronger and longer than in the latter, and the physiognomy is different.

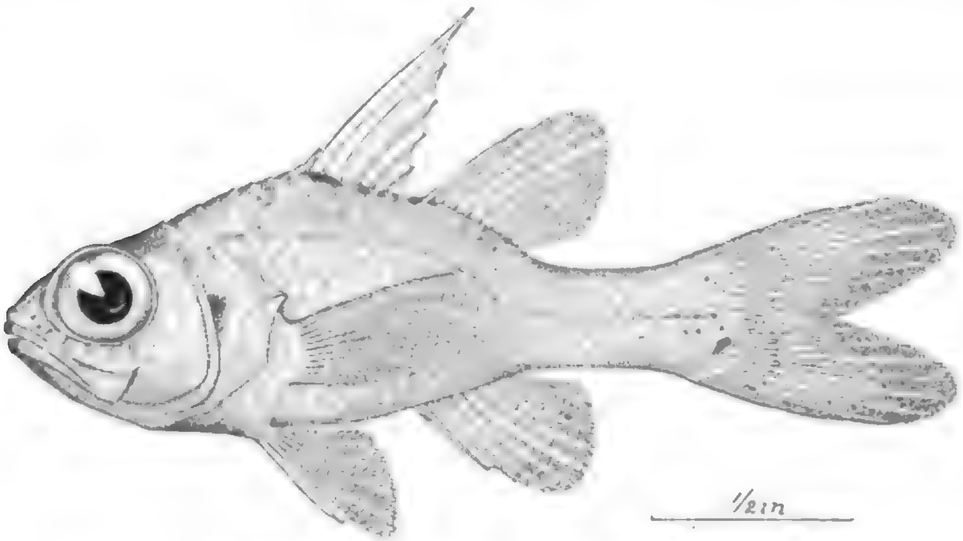

FIG. 39.—*Amia doryssa* Jordan & Seale, new species. Type.

505. Amia lateralis (Valenciennes). Samoa; Vanicolo.

Apogon lateralis Valenciennes, Nouv. Ann. Hist. Nat., I, 58, 1832, **Vanicolo.**

Head[a] 2.40 in length; depth 2.75; eye 3.75 in head; snout 4; dorsal VI–I, 9; anal II, 8; scales, 1.5–26–5; interorbital scarcely equal to eye.

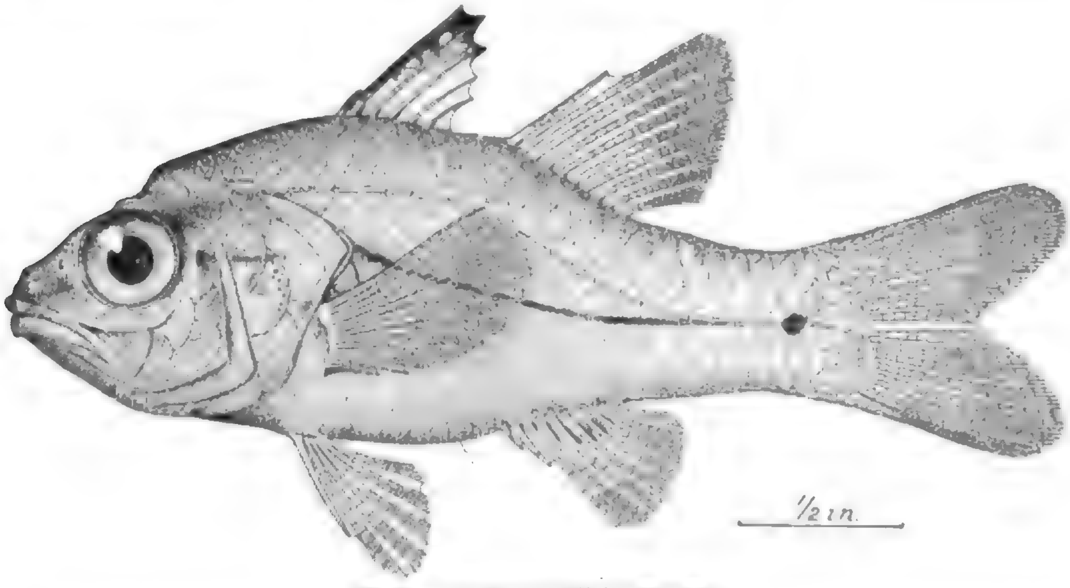

FIG. 40.—*Amia lateralis* (Valenciennes).

Body oblong, compressed, and somewhat elevated; mouth large; maxillary 2.15 in head, its distal end under posterior margin of pupil; teeth in villiform bands on jaws; vomer and palatines; cheek scaled; preopercle with the outer limb very slightly denticulate, the teeth finer above, the inner limb entire; gill-rakers strong, blunt, and finely denticulate, the longest two-thirds as long as pupil, 17 on lower limb; second dorsal spine longest, 2.20 in head; longest ray of soft dorsal, 2 in head, its base 3; caudal emarginate, the lobes rounded; base of anal, 3 in head, its longest ray, 2.50, the spines small; pectoral extending to a line with sixth dorsal ray, 1.75 in head; insertion of ventrals slightly in advance of base of pectoral, their tip extending to anal opening, their length equal to postocular part of head.

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[a] Including opercular flap in all descriptions of *Ambassis* and *Amia*.

Color in spirits, dull yellowish white with a slight wash of brown; everywhere punctulate with indistinct minute dark dots the size of pin pricks; a narrow and distinct line of brown from posterior margin of opercle to base of caudal, where it terminates in a small round black dot about half the size of pupil; a short black line from posterior margin of eye to near posterior margin of opercle, a dusky blotch above this at upper end of preopercle and including the upper portion of orbit and eye; a more or less distinct dusky line from anterior of orbit down side of snout; dorsal fin with anterior spine, dusky black at tip; other fins white; opercle gilt.

Twenty-six specimens from Apia. The specimen described is 3 inches long.

This species is rather common in the sluggish waters at the mouths of the streams of Apia. From the other Samoan species it may be known by its strong likeness to the species of *Ambassis*, among which it is often found. It has always a small black spot at base of caudal and a low spinous dorsal, the long spine barely reaching base of second dorsal when compressed.

MIONORUS Krefft. *Fb.*

This genus has the lateral line complete, the palatine provided with teeth, and the two limbs of the preopercle both strictly entire. In *M. græffei* the body is short and greatly compressed, and the dorsals high. Other species provisionally referred to the same genus (*waikiki*, *carinatus*, *glaga*, etc.) have the general form of *Amia*.

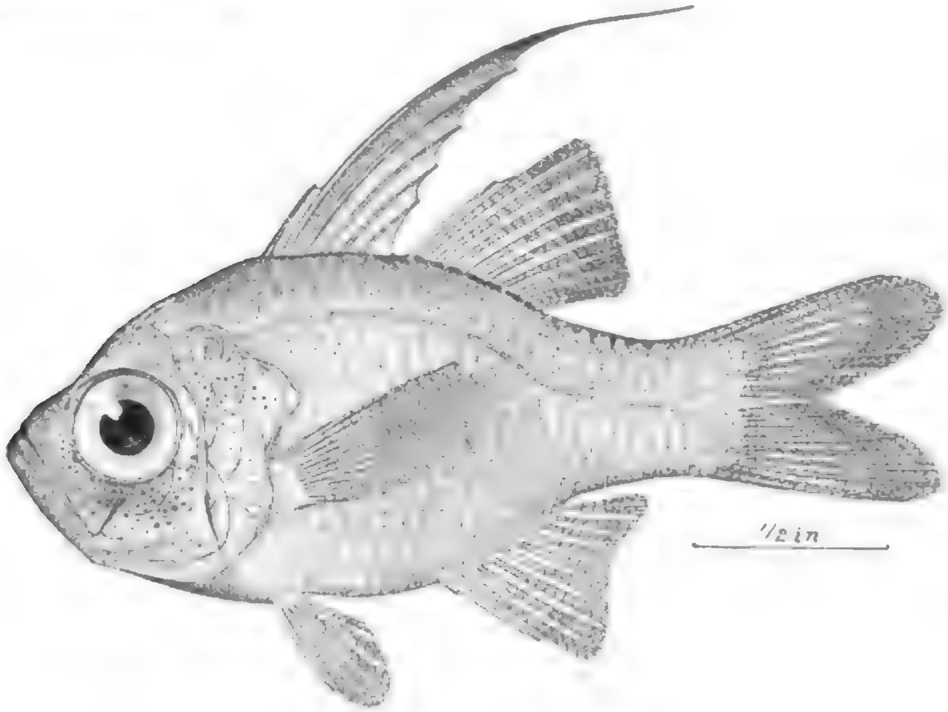

FIG. 41.—*Mionorus græffei* (Günther).

506. Mionorus græffei (Günther). Samoa; Marshall Is.

Apogon græffei Gunther, Fische der Sudsee, 22, taf. 20, fig. E, 1873, **Boston I. (Marshall Is.)**. Streets, Bull. U. S. Nat. Mus., VII, 101, 1877, Samoa.

Of this pretty species we have two specimens from Apia, and ten from Pago Pago. The greatly compressed body and elongate whip-like spine are characteristic.

Color in life of a specimen from Apia, translucent, with orange shades on head; fins plain pink, the spinous dorsal dark-edged; no stripes or spots; very deep and much compressed; second dorsal spine filamentous, reaching past middle of soft dorsal.

A specimen from Pago Pago in life was light pinkish olive; no spot or bar of black; two golden bronze cross-streaks behind head; two on opercle and two or three similar streaks radiating from eye; a streak of dark points along middle line of back; first dorsal dusky, the long whip-like produced spine black; other fins plain pink, the caudal faintly dark-edged. Caudal well forked; preopercle serrate.

The other specimen from Apia, with body very deep, was translucent olive, paler below, silvery on side; a dark streak along base of dorsal; four vertical bars of bright golden bronze behind eye on opercle and front of body, these not much above or below level of large eye; upper fins pale orange; lower pale red; pectoral colorless. Scales very large; dorsal filamentous; anal II, 10.

507. Mionorus waikiki (Jordan & Evermann). Hawaii.

FOA Jordan & Evermann. *Fo.*

Foa Jordan & Evermann, Bull. U. S. Fish Comm., XXIII, 1903 (July 29, 1905), 210 (type *Fowleria brachygramma*).

This genus is characterized by the entire preopercle, incomplete lateral line and by the presence of teeth on the palatines. The species are all very small in size, and they live in crevices of coral reefs.

Analysis of species of Foa.

a. Opercle without black spot.
  b. Body and fins plain, pale .... *brachygramma*
  bb. Body much mottled; fins mottled.
    c. Head very large; back with broad diffuse dark cross-shades .... *fo*
    cc. Head moderate; no broad blackish cross-bands .... *vaiulæ*

508. Foa brachygramma (Jenkins). Hawaii.

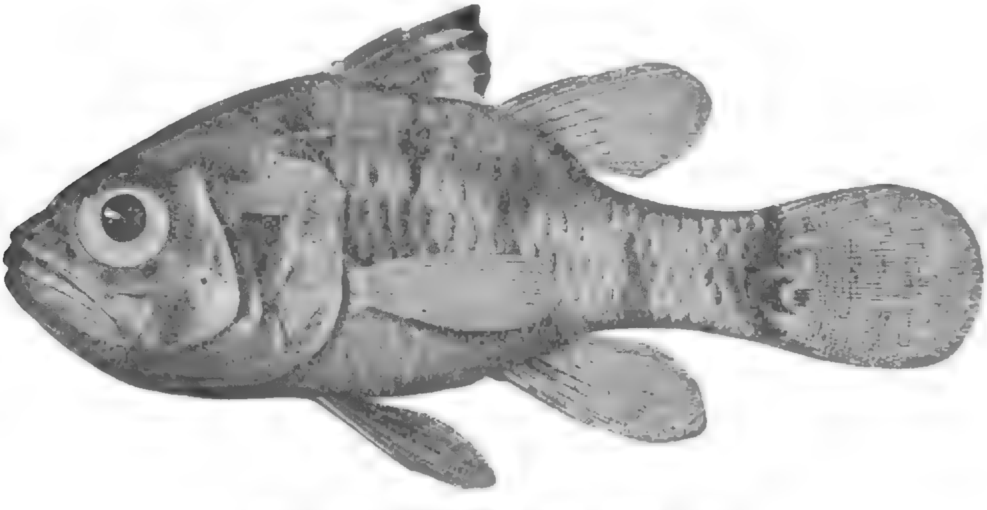

FIG. 42.—*Foa fo* Jordan & Seale, new species. Type.

509. Foa fo Jordan & Seale, new species. Samoa.

Head 2.20 in length; depth 2.50; eye 3.75 in head; snout 4.75 in head; dorsal VII-I, 9; anal II, 8; scales 1-21-6; lateral line discontinued at the ninth scale from head; interobital equal to snout.

Body oblong, compressed, rather deep; body, cheeks and opercles scaled; caudal peduncle rather short and strong, its depth 1.50 in its length, which is 1.70 in head; mouth large, the jaws equal; premaxillary equal to postocular part of head; bands of minute teeth in jaws, vomer and palatine; opercle entire; preopercle with both limbs very minutely denticulate, the denticulations being hidden under the scales; gillrakers not very sharp, rather strong, 12 on lower limb, the longest less than length of pupil; base of spinous dorsal slightly greater than its height, which is 2 in head; base of soft dorsal

3 in head, its height 1.90 in head; anal base about equal to eye, its longest ray 3 in head; pectorals 1.75 in head, extending to below middle of soft dorsal; ventral inserted directly below base of pectoral, its length 1.75 in head; caudal rounded, 1.50 in head.

Color in spirits, yellowish white, the scales shaded more or less with light brown; five diffuse, irregular vertical cross-bands of dusky, the first in front of dorsal, the second from middle of spinous dorsal, the third from base of soft dorsal, the two posterior ones encircling caudal peduncle; there is also a more or less distinct dusky area on nuchal region; dusky cross-shades under chin; the fins, except pectorals, all more or less indistinctly blotched with dusky, the spinous dorsal being black at tip with a lighter area in middle and dusky at base; anal shows indications of three or four darker cross-shades; ventral dusky; a dark spot on opercle, just posterior to eye; upper portion of orbital and snout shaded with dusky.

Of this species, well distinguished by its large head, blackish cross-bands, and by the absence of opercular spot, we have one specimen from Apia, the type, no. 51735, U. S. National Museum, 1.50 inches long. We have also 2 specimens from the Philippines. *Fo* is the Samoan name of all species of *Amia* and related genera.

510. Foa vaiulæ Jordan & Seale, new species. Samoa.

Head 2.50 in length; depth 3; eye 3 in head; snout equal to interorbital; dorsal VII–I, 9; anal II, 7; scales 2–21–6; lateral line continued only to tenth scale from head.

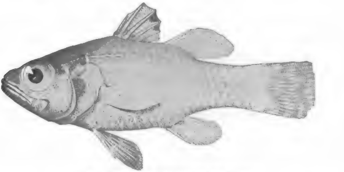

FIG. 43.—*Foa vaiulæ* Jordan & Seale, new species. Type.

Body oblong, compressed; body, cheeks, and opercles scaled; caudal peduncle rather strong, its depth 1.75 in its length, which is 1.50 in head; mouth large; jaws equal; maxillary 1.85 in head, its distal end under posterior third of eye; bands of minute teeth on jaws, vomer, and palatines; opercle entire; preopercle with very minute denticulations on each limb; gillrakers rather strong at base, sharp-pointed, the longest about two-thirds width of pupil, 7 developed on lower limb; spinous dorsal rounded, its base equal to its height; base of soft dorsal 3 in head, rounded, its longest ray 2.20; base of anal 3.50, its longest ray 2.18; pectoral 1.75, reaching anterior base of soft dorsal; ventral 1.80, its tip not reaching base of anal, their insertion below base of pectoral; caudal square, its length 1.95 in head.

Color in spirits, yellowish white, each scale shaded by numerous fine brown dots like pin pricks, darker on nuchal region, with a small but distinct black spot above opercle at origin of lateral line; some dark shadings on opercle and cheek behind and below eye; pectoral yellow, all the other fins shaded more or less with small brown dots, darkest on spinous dorsal, which also has black blotches between third and fifth spines at tip of fin and at the base; on caudal fin the dots form three irregular bands. This species is mottled somewhat as in *Apogonichthys marmoratus*, but is without opercular spot.

One specimen, type, no. 51734, U. S. National Museum, from Apia, length 1.20 inches. Named for the fisherman Vaiula, of Apia.

APOGONICHTHYS Bleeker. *Fo.*

Fowleria Jordan & Evermann, Bull. U. S. Fish Comm., XXII, 1902 (Apr. 11, 1903), 180 (*auritus*).

This genus is based on a species, *Apogon auritus* Cuvier & Valenciennes, which we have not seen. It is, however, very closely related to three Samoan species, with which it is doubtless congeneric. These species differ from the group called *Foa* in having no teeth on the palatines. In all of them there is a large black ocellus on the opercle, and the lateral line, although interrupted, shows rudimentary pores on the caudal peduncle.

a. Opercle with a large ocellated black spot.
  b. Body mottled with dusky; fins all closely chequered; lower side of head chequered .... *variegatus*
  bb. Body deep red in life, with many pale cross-bands; fins faintly mottled; caudal blackish at tip.......... *marmoratus*
  bbb. Body brown; a distinct black spot at base of many scales, forming lines; fins plain .... *isostigma*

511. Apogonichthys variegatus (Valenciennes). Samoa; Tahiti; Yap; Ile de France.

?*Apogon auritus* Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 443, 1831, **Ile de France**; color plain, fins plain, an opercular spot.

Apogon variegatus Valenciennes, Ann. Sci. Nat., I, 1832, 55, **Ile de France**; body and fins mottled; an opercular spot.

Apogon auritus, Günther, Fische der Südsee, 23, Tahiti, Yap. Day, Fishes of India. Streets, Bull. U. S. Nat. Mus., VII, 1877, 100, Samoa. Sauvage, Fish. Madagascar, 141, not plate.

This species is common on the reefs about Samoa. We have ten examples from Apia and twenty from Pago Pago. It is well figured by Day as *Apogon auritus*, but the original *auritus* is said to have the fins plain. There is a black opercular spot, and the body and fins are everywhere closely mottled with light and blackish. The vertical fins especially are finely marked, the pattern suggesting that of the fins of some gobies.

This species may be the original *Apogon auritus*, but it can not be identified as that without comparison with the original type. *Apogon punctulatus* of Rüppell and *A. polystigma* of Bleeker may be the true *auritus*. At any rate, the figures diverge widely from our fish. The description of *A. auritus* of Sauvage approaches it, but his figure looks much like *Foa brachygramma*.

Life colors of a specimen from Apia, body everywhere much mottled, blackish, and gray; all the fins save the ventrals elaborately spotted and barred; jaws barred and mottled; a black ocellus on the opercle.

Another specimen from Apia was dirty olive-brown; opercle with a black pale-edged ocellus, very large and conspicuous; fins all much like the body, brown and mottled; caudal rounded.

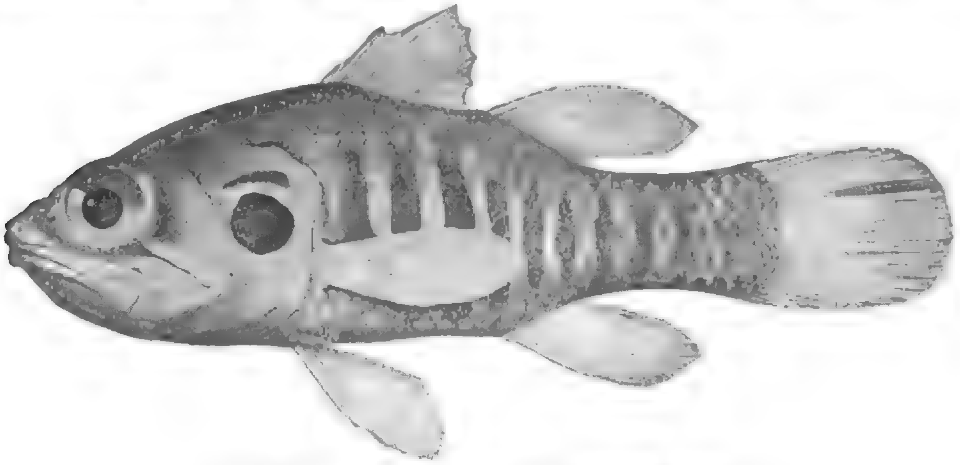

FIG. 44.—*Apogonichthys marmoratus* (Alleyne & Macleay).

512. Apogonichthys marmoratus (Alleyne & Macleay). *Fo mumu* (red). Samoa; North Australia.

Apogonichthys marmoratus Alleyne & Macleay, Proc. Linn. Soc. N. S. W., 1876, 268, pl. V, fig. 2, **Cape Grenville (North Australia)**.

Of this species, distinguished by its clear red color, black opercular spot, and the body covered with pale crossbands, we have three specimens from Pago Pago, and ten from Apia. It is well separated from *Apogonichthys variegatus*. The little figure given by Alleyne and Macleay is characteristic.

Life colors of one specimen from Pago Pago, light clear brownish red, the ground-color forming about nine distinct crossbars on the body, about twice as broad as the pale olive interspaces; head mottled; a large black spot on opercle, washed with golden and surrounded by a golden ring, this spot two-thirds diameter of eye and covering most of the bone; fins all very bright cardinal red, the caudal with an irregular black shade at tip. Caudal rounded. Length 2¼ inches.

513. Apogonichthys isostigma Jordan & Seale, new species. Samoa.

Head 2.55 in length; depth 3; eye 4 in head; snout equal to eye; dorsal vii-i, 9; anal ii, 8; scales 2-22-6, the lateral line interrupted; interorbital less than snout, 1.75 in orbit.

Body oblong, compressed, scaled, the scales covering cheeks and opercles; depth of caudal peduncle 1.30 in its length; mouth large, the lower jaw slightly the shorter; maxillary 2 in head, its distal end under posterior margin of orbit, the distal width being greater than pupil; teeth in villiform bands on jaws and vomer, no teeth on palatines; opercle entire; preopercle apparently entire, but with a few slight serrations at angle hidden under the skin; gillrakers short, the longest 2 in pupil, blunt, ending in a prickly knob, 7 developed on lower limb; base of spinous dorsal equal to its height, which is 2.10 in length of head; base of soft dorsal 1.50 in its longest ray, which is 2 in head; ventrals do not reach to the anal, their length 1.75 in head, their insertion directly below base of pectoral; pectoral 1.50 in head, terminating at the seventh round black spot on side; caudal rounded, 1.40 in head.

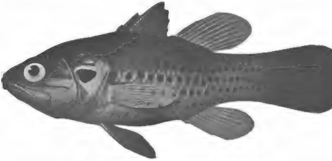

Fig. 45.—*Apogonichthys isostigma* Jordan & Seale, new species. Type.

Color in spirits, light brown, with about five rows of distinct round dots forming the center of scales along the sides, two of these lines with their origin at axil of pectoral and extending to caudal, one with its origin at posterior tip of opercle and extending to caudal, the other two usually extending from near middle of fish to caudal (very old examples show a few other scattered dots over the body); a large, black, white-edged spot on opercle, a more or less distinct dusky area extending from eye back to this spot; a narrow black line from lower part of orbit across cheek; top of head and snout dusky, a narrow dark line across opercle just above the black spot; all the fins except pectorals have a wash of dusky, the caudal being almost black; pectoral yellowish white.

Life colors of one specimen plain dark brown, each scale with a darker spot, these forming dark streaks along scales, but no marblings; large opercular ocellus with a golden edge; fins dark brown, unspotted.

This species has the large opercular ocellus found in *Apogonichthys auritus, polystigma, variegatus* and *marmoratus*. The body is, however, marked with large distinct spots, about one on each scale, arranged in regular lines; the fins are dusky but unspotted, and there is an oblique dark line below and behind the eye.

The species is nearest *Apogonichthys polystigma* Bleeker, but it does not seem to agree with Bleeker's account. It is not unlikely that Bleeker's fish is the original *Apogon auritus*. It is certainly different from *Apogonichthys variegatus*. *Apogon auritus* Seale (Bishop Mus. 1901, 76) from Guam, must be the present species.

Nine specimens from Apia. The type is no. 51736, U. S. National Museum, and is 2.67 inches long.

ARCHAMIA Gill.

514. Archamia lineolata (Ehrenberg). *Fo.* Samoa; Vanicolo; East Indies. (Pl. XXXVIII, fig. 1.)

Apogon lineolatus Ehrenberg in Cuvier & Valenciennes, Hist. Nat. Poiss., II, 160, 1828, **Red Sea.** (Anal II, 14.)
Apogon macropterus Kuhl & Van Hasselt in Cuvier & Valenciennes, Hist. Nat. Poiss., II, 160, **Java.** (Anal II, 13.)
Apogon ceylonicus Cuvier & Valenciennes, op. cit., III, 491, **Ceylon.** (Anal II, 13.)
Apogon argenteus Valenciennes, Ann. Mus. Nat. Hist. 1832, 60. **Vanicolo.** (Anal II, 14.)
Apogon fucatus Cantor, Cat. Malay., 4, 1850, **Penang.** (Anal II, 16.)
Apogon notatus Day, Proc. Zool. Soc. 1870, 936, **Madras.** (Anal II, 16.)

This species is very abundant about the reefs of Samoa. We have about twenty specimens from Pago Pago and forty from Apia. We find no specimens with fewer than 16 soft rays in the anal fin. Possibly two species (*fucatus* and *lineolatus*) have been confounded, the latter with fewer rays.

The species is subject to considerable variation. The delicate orange cross-streaks characteristic in life mostly fade in spirits. Only in the very largest specimens is a large black scapular spot distinct; usually there is no trace of it. In some specimens there is a round black spot at base of caudal; in most there is only a diffuse black blotch or cluster of black points. In some the sides of the head are profusely speckled, in others clear silvery. All show a faint silvery horizontal streak just before and just behind eye. In all the body is deep, but there is considerable variation. The variations in color are somewhat parallel with those in *Amia savayensis.*

Life colors of a specimen from Apia, light soiled pinkish olive, with many dark specks; sides silvery; body with 18 narrow curved cross-streaks of bronze orange. A large black blotch covering whole side of tail; scapular spot obsolete; fins all light rosy. Depth 2.25 to 2.50 in length.

Another specimen from Apia was light clear pink; about 15 narrow curved cross-streaks of bright rosy, some golden on cheek; a blackish stripe across eye and cheek; a round black spot on scapular region, and a larger and blacker one on tail at middle of base of caudal; fins all rosy, the caudal dusky shaded; iris golden, before and behind.

PARAMIA Bleeker.

(*Cheilodipterus* Cuvier & Valenciennes; not of Lacépède.)

515. Paramia quinquelineata (Cuvier & Valenciennes). *Mata uliuli.* Samoa; New Guinea; Raiatea and Nukahiva (Seale)

This species is abundant about Samoa. We have about 40 examples from Apia and Pago Pago. The species is known at once by the black streaks, about 5 in number, which do not quite reach a black caudal spot which is in the center of a golden area.

Life colors of a specimen from Pago Pago, brownish, with about 5 stripes of black; a yellow ocellus around a black spot at the base of caudal.

A specimen from Apia was translucent olive; a round jet black spot at base of caudal with a broad golden yellow border; six black stripes along side; fins dirty translucent, the dorsal darker in front; ventral pinkish; no other red.

516. Paramia macrodon (Lacépède). *Tuganini.* New Guinea (Macleay); Samoa; East Indies.

(*Cheilodipterus octovittatus* Cuvier & Valenciennes.)

This large species, reaching a length of eight inches, is rather common at Samoa. We have about twenty specimens from Apia and Samoa. It is known by the diffuse black caudal blotch and by the presence of about eight dark stripes on each side.

Life colors of a specimen from Apia, pale translucent olive; with 7 to 9 streaks of soiled bronze, as wide as interspaces, the middle stripes plainer; one on middle line before dorsal; 7 on head besides a black band through eye; a broad diffuse black bar at base of caudal; fins all reddish, dusky shaded.

A larger example shows the streaks but faintly; first dorsal and ventrals tipped with black; caudal irregularly black-edged.

517. Paramia truncata (Günther). Misol.

Cheilodipterus truncatus Günther, Cruise Curaçao, 1872, 418, **Misol.**

SYNAGROPS Günther.

518. Synagrops argyrea (Gilbert). Deep seas of Hawaii.

Family AMBASSIDÆ.

AMBASSIS Lacépède.

Ambassis Cuvier & Valenciennes, Hist. Nat. Poiss., ii, 1829 (*ambassis*).

The generic name *Chanda* has priority over *Ambassis*, as Cantor and Waite have recognized, but Fowler, the first reviser of *Chanda*, has made its type identical with the type of Bleeker's genus *Pseudambassis*. Pending a final agreement on the rule of nomenclature governing this case, we may follow Fowler's arrangement.

Ambassis, or *Chanda*, is characterized among related genera by the serrated preorbital, small teeth, large scales, complete lateral line, and the presence of about ten rays in the dorsal fin. A procumbent dorsal spine is always present, but in the Samoan species it is very small and concealed in the flesh. The weakness of this spine defines the genus *Pseudoambassis* of Castelnau, a group which we think inseparable from *Ambassis*. *Pseudambassis* of Bleeker is apparently a valid genus, with long anal fin and small scales. *Priopis* Kuhl & Van Hasselt differs from *Aspro* in the interrupted lateral line.

Hamilton-Buchanan's *Chanda* (*ovata=nama*), which is the same as *Bogoda* Bleeker, is characterized by the uninterrupted lateral line, small scales, and strong curved canines. *Parambassis* Bleeker, with canine teeth and a short anal fin, is apparently a valid genus.

519. Ambassis lafa Jordan & Seale, new species. *Lafa*. Samoa.

Head 2.60 in length; depth equal to head; eye 3.45 in head; snout 5; dorsal vii, i, 10; anal iii, 11, scales 3-31-6; interorbital 4.

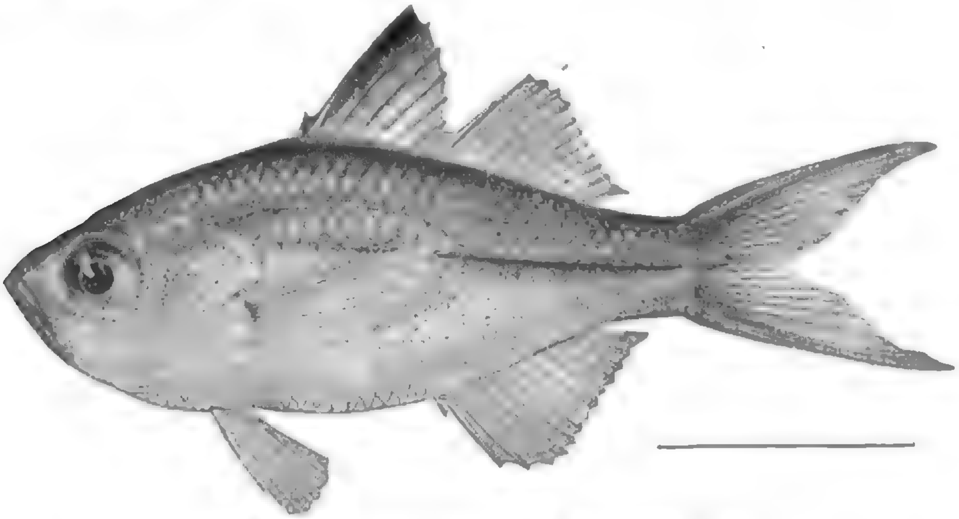

Fig. 46.—*Ambassis lafa* Jordan & Seale, new species. Type.

Body oblong, compressed, slightly elevated; profile of head slightly concave over eye; body, opercles, and cheeks scaled; mouth rather large; maxillary 2.75 in head, its distal end under anterior margin of pupil; lower jaw slightly the longer, minute villiform teeth in jaw, vomer and palatines, the inner row in jaws depressible, tongue smooth; gillrakers pointed, equal to width of pupil, 20 on lower limb; opercle entire; preopercle with flat spine at angle and the lower limb only serrated, the outer limb strongly denticulate below; depth of caudal peduncle greater than length of maxillary, 2.25 in head; second upright dorsal spine the longest and strongest, 1.50 in head; connection of soft with spinous dorsal very narrow, less than width of pupil; spine of soft dorsal 2.25 in head, the longest ray 2 in head; base of anal equal to distance from middle of eye to posterior tip of opercle, its longest ray equal to longest ray of dorsal; pectoral equal to distance from anterior of eye to posterior tip of opercle; ventral equal to base of anal; length of third anal spine 2.30 in head, the second but little shorter, the first very small; caudal deeply forked, its lobes about equal to head; the ventrals are slightly in advance of base of pectorals. Lateral line continuous.

Color in life yellowish white, darker above, the margins of each scale being shaded with minute brown dots; a dark line from base of caudal along median line of body, fading out near the opercle; tip of snout, upper part of snout, interorbital, and upper half of eye dusky; dusky shading on first web of spinous dorsal; all the fins more or less punctulate with minute brown dots like pin points; opercle gilt; lower half of eye golden yellow; darker shadings along base of dorsal and anal, and a dusky line on under side of caudal peduncle, more distinct in the young, in which the line extends along the belly.

Color in life of a specimen from fresh water at mouth of Vaisigano River, Apia, olive, sides silvery, with a silvery lateral stripe; scales all dark-edged; fins dirty olive, with no trace of red markings, except that front of spinous dorsal is marked with dull orange.

This species is very abundant in the lower waters of the Vaisigano River and other streams of Upolu. We have upwards of a hundred specimens. The spinous dorsal is high, the spine reaching middle of second dorsal.

Type no. 51818, U. S. National Museum, a specimen 3.69 inches long, from near mouth of Vaisigano River, Apia.

520. Ambassis vaivasensis Jordan & Seale, new species. *Lafa.* Samoa.

Head 2.75 in length; depth equal to head; eye 3.10 in head; dorsal VII-I, 9; anal III, 9; scales 2-27-5; interorbital 4; snout 1.50 in eye.

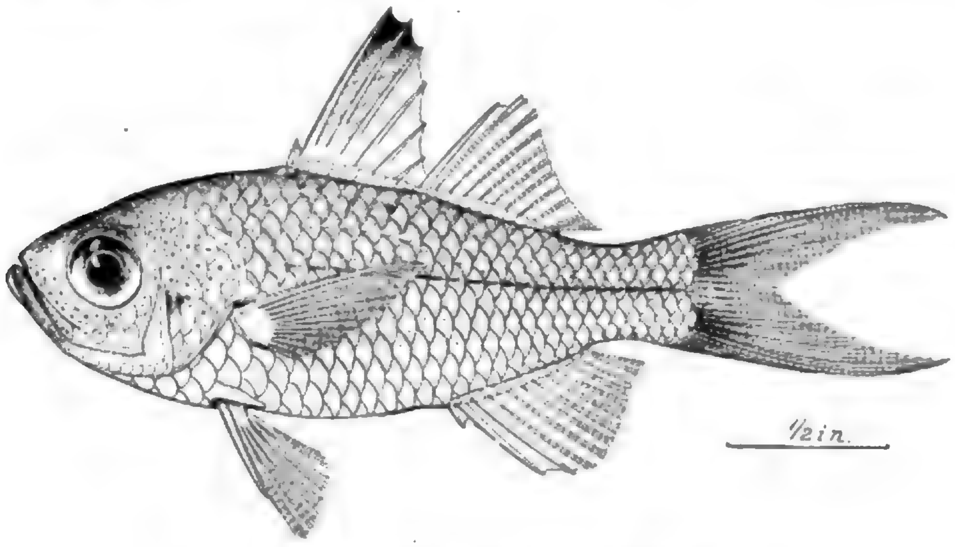

FIG. 47.—*Ambassis vaivasensis* Jordan & Seale, new species. Type.

Body oblong, compressed, scarcely elevated, the scales of moderate size, covering opercles and cheeks; mouth large; profile of head slightly concave over middle of eye; maxillary 2.75 in head, its distal end under anterior margin of pupil; lower jaw slightly the longer; bands of villiform teeth in jaws, vomer and palatines, the inner series in jaws depressible; gillrakers rather slim, sharp-pointed, longest equal to pupil, 24 on lower limb; opercle entire, ending in a sharp-pointed flap; preopercle with flat spine at angle and denticulated on its lower limb; lower margin of outer limb of preopercle toothed; depth of caudal peduncle equal to length of maxillary; second (upright) spine of dorsal the longest and very strong, 1.40 in head; connection of soft with spinous dorsal very narrow, about one-half width of pupil; spine of second dorsal 2 in head, the longest ray 1.75; caudal deeply forked, the lobes pointed, the longest ray 2.50 in length; base of anal equal to distance from middle of eye to posterior tip of opercle, its longest ray equal to longest ray of dorsal; of the three anal spines the first is very short, the second is long, 2 in head, the third is the longest, 1.80; pectoral reaching to a line with second dorsal ray, 3 in total length; base of ventrals directly over base of pectorals, length 1.50 in head; lateral line continuous.

Color in spirits, yellowish white, the back and upper part of sides slightly shaded with minute punctulations of brown; a silvery band along the median line of side from posterior margin of opercle to caudal, the band becoming more distinct posteriorly with a slight shading of brown; tip and first membrane of spinous dorsal shaded with dusky; base of caudal with slight shading of dusky, other fins white without markings; opercles gilt; upper part of orbit and eye dusky, lower part golden. The side is marked by a silvery streak with no caudal spot or crossbar.

This species is rather common in the Vaisigano, Vaivase, and other streams of Upolu.

Thirty-one specimens from Apia, Samoa. The type is no. 51819, U. S. National Museum, from Vaivase River, Apia; length 2.50 inches.

521. Ambassis miops Günther. Rarotonga.

Ambassis miops Günther, Proc. Zool. Soc. Lond. 1871, 655, **streams of Rarotonga.**

522. Ambassis gigas (Ramsay & Ogilby). Streams of New Guinea.

Ambassis gigas Ramsey & Ogilby, Proc. Linn. Soc. N. S. W. 1886, 9, **New Guinea.**

523. Ambassis macracanthus (Bleeker). Streams of New Guinea (Macleay); Java.

PRIOPIS Kuhl & Van Hasselt.

524. Priopis papuensis (Alleyne & Macleay). Streams of New Guinea.

Ambassis papuensis Alleyne & Macleay, Proc. Linn. Soc. N. S. W. 1876, 267.

525. Priopis agrammus (Günther). New Guinea (Ramsay & Ogilby); North Australia.

Ambassis agrammus Günther, Ann. Mag. Nat. Hist. 1867, 57, **Cape York.**

TETRACENTRUM Macleay.

Dorsal fin continuous; anal spines four. Otherwise resembling *Amia* (*Apogon*).

526. Tetracentrum apogonoides Macleay. Streams of New Guinea.

Tetracentrum apogonoides Macleay, Proc. Linn. Soc. N. S. W. 1883, 256, **Goldie R.** (**New Guinea**).

Family KUHLIIDÆ.

KUHLIA Gill.

527. Kuhlia rupestris (Lacépède). *Sesele.* Samoa; Guam; Vanicolo; Fiji; Tonga; Rodriguez; Futuna; New Hebrides; Molicolo; New Guinea; Solomon Is.; Caroline Is.; Palau Is.; New Caledonia; East Indies.

This species, which closely resembles the American black bass in form and habits, is very common in all the rivers of Samoa, where it reaches a weight of 5 or 6 pounds. Many specimens were taken, most of them from the deep swimming-pool in the Vaisigano River above Apia.

528. Kuhlia marginata (Cuvier & Valenciennes). *Salele.* Fiji; Tahiti; Samoa; Gilbert Is.; Papua; Bonham I.; Misol; East Indies.

This species is found in the river mouths of Samoa, about a dozen specimens, mostly small, being taken in the Vaisigano River at Apia.

529. Kuhlia urvillii Boulenger. South Pacific; locality unknown.

530. Kuhlia malo (Cuvier & Valenciennes). Hawaii; Tahiti; Tubuai; Paumotu Is. (Seale); Fiji; Rodriguez; Laysan.

531. Kuhlia tæniura (Cuvier & Valenciennes). *Safole.* Samoa; Johnston I.; Marcus I.; Tubuai; Paumotu Is.; and Tahiti (Seale); East Indies; Galapagos Is.

This species, unlike the others of the genus, never enters fresh water, nor is it found about the reefs. It frequents the "iron-bound," or lava, coast in rather deep water. Our specimens, about a dozen in number, were taken on the northwest shore of Tutuila, opposite Pago Pago.

532. Kuhlia caudovittata (Lacépède). Tahiti.

Family SERRANIDÆ.

PLECTROPOMUS (Cuvier) Oken. (*Lates* Cuvier & Valenciennes.)

533. Plectropomus calcarifer (Bloch). New Guinea (Macleay); Australia.

PIKEA Steindachner.

534. Pikea aurora Jordan & Evermann. Hawaii.

CHORISTISTIUM Poey.

This genus has been hitherto known from a single species taken by Poey in Cuba, and named *Chorististium rubrum*. The discovery of a second species is most interesting.

535. Chorististium susumi Jordan & Seale, new species. *Susu umi.* Samoa.

Head 2.55 in length; depth 3.40; eye 4.50 in head; dorsal VI-I, 10; anal III, 8; scales 3-49-11; interorbital equal to eye.

Body elongate, compressed; scales of moderate size, striated and ciliated, entirely covering head and body; lateral line strongly curved, the straight portion 2 in curved; snout rather wide but acute; the lower jaw slightly the longer; maxillary 2.40 in head, extending to posterior third of eye; a distinct supplemental bone; mouth large, with broad bands of villiform teeth in jaws, vomer and palatines, the inner row in jaws slightly longer and depressible; no teeth on tongue; gillrakers equal to one-half eye, 13 on lower limb; longest spine of dorsal 2.75 in head; distance between last dorsal spine and origin of soft dorsal 4.50 in head; base of soft dorsal equal to depth of caudal peduncle, its margin somewhat rounded, its longest ray 2 in head; caudal bilobed, its longest ray 2 in head; base of anal equal to longest (2nd) anal spine; its longest ray 2.10 in head; pectoral equal to distance from middle of eye to posterior margin of opercle; ventrals inserted directly below the base of pectorals, their length 1.55 in head; opercle armed with three flat spines, the two lower ones closest together; preopercle slightly serrate.

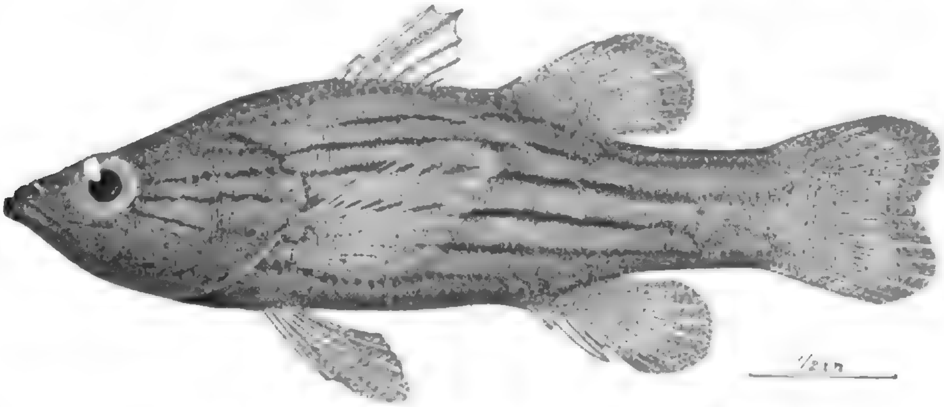

Fig. 48.—*Chorististium susumi* Jordan & Seale, new species. Type.

Color in spirits, light brown, with seven longitudinal lines of deeper brown on sides; four of these lines arise from posterior margin of orbit and extend to or near base of caudal, the remaining three seem to arise at margin of opercles and extend about to a line with axis of soft dorsal; fins all uniform yellowish white.

Life colors of one specimen from Apia, dark brown suffused with red, redder below and behind; about seven olive-red stripes, very dark on body, these not extending much on head; fins all plain bright cherry red.

Two specimens from the reef at Apia. The type is no. 51738, U. S. National Museum, 3.10 inches long.

CENTROGENYS Richardson.

536. Centrogenys waigiensis (Quoy & Gaimard). New Guinea; Australia; East Indies.

PARACANTHISTIUS Bleeker.

(*Plectropoma* Boulenger, not *les Plectropomes* of Cuvier = *Plectropomus* Oken.)

537. Paracanthistius maculatus (Bloch). Samoa, Louisiades; Fiji, Palau Is.; New Guinea (Macleay); Faté (Seale).

One large example taken at Apia. It belongs to the form called *leopardus*, the body covered with round blue dark-edged spots, none of them elongate. This is apparently not specifically distinct from the true *maculatus*, in which these spots are larger, some of them oblong or elongate.

538. Paracanthistius oligacanthus (Bleeker). Caroline Is.; East Indies.

ANYPERODON Günther.

539. Anyperodon leucogrammicus (Cuvier & Valenciennes). *Gatala alera.* Samoa; Ponape; Caroline Is.; New Hebrides; New Guinea (Macleay); East Indies.

Of this handsome species, 7 adult specimens were taken at Apia. Life colors of one of these, clear olive-green, with 4 faint interrupted stripes of white, the second and third widened and distinct at intervals, forming 2 white spots on side; lowest stripe very distinct across cheek; side with about 8 rows of bright orange-brown spots, not ocellated or reticulated; head with smaller spots; lower parts of head coppery red; spinous dorsal olive with 3 rows of large orange spots; second dorsal, anal, and caudal green, dorsal and anal with a spot at base of each ray; pectoral pale olive; ventral dusky olive, both unspotted. Body elongate; caudal rounded; teeth in 2 rows below.

VARIOLA Swainson.

540. Variola louti (Forskål). *I'a manaia.* Tahiti; Samoa; Paumotu Is.; New Hebrides; Solomon Is.; Marshall Is.; Faté (Seale).

Of this beautiful and widely diffused species, 10 specimens of different sizes were taken at Apia and Pago Pago.

Life colors of a specimen from Pago Pago, greenish above, rosy below; upper spots clear violet; lower lateral spots cherry-red; crimson on tail, the edges of spots dark, the spots largely lake; dorsal deep red, with spots of violet and lake; caudal similar, similarly golden behind; pectoral purplish, pale golden behind, violet spotted at base; ventral clear red, red spotted at base, tinged with golden at tip; spots arranged in lines, the lateral spots oblong.

541. Variola flavimarginata (Rüppell). Samoa; East Indies.

Serranus flavimarginatus Rüppell, Atlas Rothen Meeres, 109, 1828, **Red Sea.**

Variola flavimarginata, Bleeker, Verh. Ak. Amst., IV, 9, 1873, East Indies. Bleeker, Atlas Ichth., VII, 23, tab. CCLXXXIX, fig. 1.

Serranus melanotænia Bleeker, Act. Soc. Sci. Ind. Ned., II, 1857, **Amboina.**

Of this rare species, overlooked by Dr. Boulenger, we have one fine specimen from Apia. It has the general form of *Variola louti*, but a very different coloration, there being a broad black band along the upper part of the side.

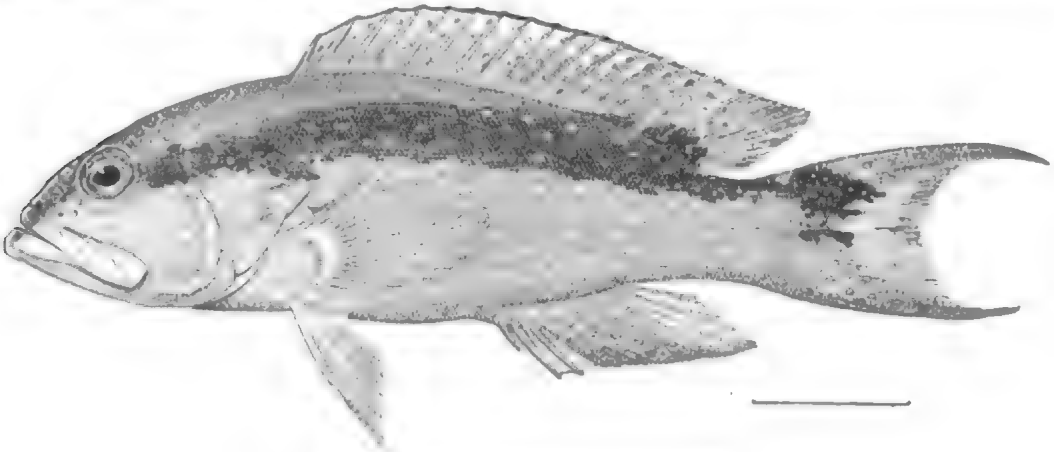

FIG. 49.—*Variola flavimarginata* (Rüppell).

Life colors, ground-color pinkish salmon, whiter region behind pectoral; a velvet blackish longitudinal band, side above brownish salmon; spots whitish below and posteriorly; elsewhere purple-pink with lake border.

CEPHALOPHOLIS Bloch & Schneider.

This genus, as here understood, differs from *Epinephelus* in having but 9 dorsal spines. There is considerable difference among the species in the form of the skull, but in this regard few of the Pacific species have been examined. It here includes *Enneacentrus* and *Petrometopon* of Gill, *Menephorus* of Poey, and *Bodianus* Cuvier (not of Bloch).

542. Cephalopholis argus (Bloch). *Gatala moana* (blue spotted); *Gatala uli; Vaiania.* Samoa; Hawaii; Borabora; New Guinea; Marquesas Is.; Papua; New Britain; Tahiti; Tubuai and Rarotonga (Seale); East Indies.

Common about the reefs of Samoa. Life colors of a specimen from Pago Pago, dark gray all over, with evenly disposed rather pale-blue spots with blackish edge; caudal with narrow white margin; dorsal with very narrow white margin on posterior half; pectoral paler than body.

543. Cephalopholis miniatus (Forskål). Samoa (Boulenger); Apamana; New Guinea (Macleay); New Britain (Peters); Shortland Is. (Seale).

544. Cephalopholis boenack (Bloch). New Guinea (Macleay).

545. Cephalopholis urodelus (Forster). *Mata'ili.* Tahiti; Kingsmill Is.; Harvey Is.; Paumotu Is.; Samoa; Solomon Is.; New Guinea; Uene, Society Is.; Misol; New Hebrides; Micronesia; Fanning Is.; Funafuti, Ellice Is.; Mangareva (Seale); East Indies.

Of this handsome species, 4 specimens were taken at Apia. Life colors of one, deep brick-red, darker olivaceous on back, the posterior parts almost black, the belly and sides paler and brighter red; head closely covered on sides with vermilion spots, the ground-color forming reticulations around them; body spotted with small vermilion spots which are sparse and show faintly on the ground-color; opercular flap olivaceous; dorsal dark red, the edge bright red, the narrow margin dusky; anal similar but brighter, with broader margins; traces of vermilion spots; caudal red-black, very dark, with two white cross-bands, converging behind, cutting off the dusky red corners; ventral vermilion with a dark edge; pectoral vermilion at base, then blackish, the edge broadly dull orange.

Another specimen was brown, with yellow-greenish tinge; dorsal with two yellow-white spaces interrupting brown, and with posterior third with yellow white edge; caudal with angulated transverse yellow white bar, also narrower terminal bar yellow white; anal with one yellow white blotch; ventral blackish brown; pectoral yellow white with brown blotch at base and two weakly indicated brownish cross-bands; sides of body and head with creamy white blotches.

546. Cephalopholis leopardus (Lacépède). *Gatala uli.* Samoa; Tahiti; Louisiades.

Of this species, 8 specimens were taken at Apia. Life colors of one of these, dark olive, with round scarlet spots on side; a black opercular spot; a black spot on tail below axil of dorsal, a smaller one behind it; dorsal reddish olive, with a scarlet margin; caudal with deep red convergent bands, a yellow stripe within each, the outer margin whitish; anal mottled red and bluish with a broad scarlet band and grayish edge; pectoral orange; ventral red; lips cream and olive mottled, reddish within.

547. Cephalopholis aurantius (Cuvier & Valenciennes). New Ireland; Louisiades; East Indies.

548. Cephalopholis sexmaculatus (Rüppell). Tahiti; Paumotu Is.

549. Cephalopholis sonnerati (Cuvier & Valenciennes). Kingsmill I.; Palau Is.; East Indies.

EPINEPHELUS Bloch.

550. Epinephelus merra Bloch. *Gatala; 'Ata'ata pulepule.* Samoa; Marcus I.; New Ireland (Peters); Tahiti; Guam (Seale); Fiji; New Hebrides; Solomon Is.; New Guinea (Macleay).

This species is excessively common about the reefs of Samoa, the young living in every crevice, by far outnumbering all other species of this family. About 50 specimens were preserved.

Life colors of a specimen from Apia, very dark olive-brown, the ground-color reduced to hexagonal spots surrounded by whitish olive reticulations, which are broader and clearer below; spots on head smaller; fins all similarly marked; edge of dorsal dusky, with a paler streak below. Gill-rakers 12.

Another specimen from Apia was olivaceous, dark above, the spots dull orange with darker centers; those on dorsal more orange, the interspaces grayish olive; maxillary, branchiostegals, and belly also spotted. Gill-rakers 12.

551. Epinephelus stellans (Richardson). Samoa; East Indies.

Of this species, apparently distinguished from *Epinephelus merra* by the presence of small white spots scattered over the body, among the larger dark ones, we have 3 examples from Samoa.

552. **Epinephelus dæmeli** (Günther). *'Uo'uo.* Guam; Samoa; Norfolk I.; New Guinea; Solomon Is. (Seale); Australia.

Of this species we have two large specimens from Apia. Life colors of one, very dark olive with many fine brown spots, gray reticulations around them on cheeks and jaws; five black irregular blotches on back, and two below it; one blotch on back of tail; fins all mottled and barred obscurely, reddish brown, olive and black. Ten gill-rakers.

The other specimen was olive-gray, closely covered with small dark brown spots which are larger below; a large black blotch on back of tail; fins all dusky, all spotted like the body, pectoral paler.

553. **Epinephelus fuscoguttatus** (Forskål). Samoa; Marshall Is.; Tonga; Greenwich Is.; New Guinea (Macleay, as *Serranus microdon*); East Indies.

Of this species, we have 6 specimens, large and small, from Apia. They agree fairly with Bleeker's plate.

Life colors of one specimen, olive, rather pale, with round brown spots which are narrower than the interspaces; a dark brown moustache behind the maxillary; upper jaw spotted; a black saddle on caudal peduncle; dorsal, caudal, and head spotted like body; caudal dusky behind with whitish edge; anal similar, less spotted; ventral similar; caudal with smaller spots. Gill-rakers 12; preopercle rounded, feebly notched and spined.

554. **Epinephelus corallicola** (Cuvier & Valenciennes). Samoa; Mortlock Is.; Caroline Is.; Greenwich I.; Howland I.; New Guinea (Macleay).

Of this species, we have one example from Apia. It agrees fairly with Günther's figure of *Serranus howlandi.*

Life colors, margin of caudal bright golden yellow, pectoral with margin weakly orange yellow, body with flesh-brown polygonal blotches.

555. **Epinephelus macrocephalus** (Lacépède). Kingsmill I.; Mortlock Is.; Ponape: Rodriguez; East Indies; New Guinea (Macleay).

556. **Epinephelus maculatus** (Bloch). Samoa; Papua; Marshall Is.; Caroline Is.; Shortland I.; Paumotu Is. (Seale).

Of this well-marked species, we have one young example from Apia.

557. **Epinephelus fasciatus** (Forskål). Louisiades; Tahiti; Paumotu Is.; New Britain; Bonham I.; New Guinea; Mangareva (Seale); Japan; East Indies.

558. **Epinephelus chlorocephalus** (Cuvier & Valenciennes). Tonga; East Indies.

559. **Epinephelus australis** (Castelnau). New Britain (Boulenger); Australia.

560. **Epinephelus pachycentron** (Cuvier & Valenciennes). Louisiades; East Indies.

561. **Epinephelus summana** (Forskål). Caroline Is.; New Guinea; Shortland I. (Seale); East Indies.

562. **Epinephelus megachir** (Richardson). Louisiades; New Guinea (Alleyne & Macleay as *Serranus alatus*); East Indies.

563. **Epinephelus sexfasciatus** (Cuvier & Valenciennes). Louisiades; East Indies.

564. **Epinephelus tauvina** (Forskål). Louisiades; Ponape; Palau Is.; East Indies.

565. **Epinephelus quernus** Seale. Hawaii.

566. **Epinephelus undulosus** (Quoy & Gaimard). Misol; Shortland I. (Seale); East Indies.

567. **Epinephelus spiniger** (Günther). Marcus I. (Bryan & Herre, Bishop Mus., II, 1903, 129).

568. **Epinephelus cæruleopunctatus** (Bloch). New Britain (Peters); East Indies.

569. **Epinephelus socialis** (Günther). Tahiti; Kingsmill I.; Paumotu Is.; Samoa (Boulenger).

We did not find this species, recorded from Samoa by Dr. Boulenger.

570. **Epinephelus magnificus** (Macleay). New Guinea.

Serranus magnificus Macleay, Proc. Linn. Soc. N. S. W. 1883, 229, **New Guinea.**

571. **Epinephelus albopunctatus** (Boulenger). Marquesas Is.

572. **Epinephelus goldiei** (Macleay). New Guinea; New Caledonia.

Serranus goldiei Macleay, Proc. Linn. Soc. N. S. W. 1883, 226, **New Guinea.**

ODONTANTHIAS Bleeker.

573. **Odontanthias fuscipinnis** (Jenkins). Hawaii.

PSEUDANTHIAS Bleeker.

574. **Pseudanthias kelloggi** (Jordan & Evermann). Hawaii.

575. **Pseudanthias hypselosomus** (Bleeker). New Guinea.

576. **Pseudanthias mortoni** (Macleay). New Guinea.

Anthias mortoni Macleay, Proc. Linn. Soc. N. S. W. 1883, 253, **Moresby I. (New Guinea).**

ANTHIAS Bloch.

577. **Anthias manadensis** Bleeker. New Guinea (Macleay); East Indies.

578. **Anthias cheirospilos** Bleeker. New Guinea (Macleay); East Indies.

CAPRODON Schlegel.

579. **Caprodon schlegeli** Günther. Hawaii; Japan.

GRAMMISTES Bloch & Schneider.

580. **Grammistes sexlineatus** (Thunberg). Samoa; Tahiti; Solomon Is.; New Guinea; New Hebrides; Kingsmill I.; Marquesas Is. (Seale). (Pl. XXXVIII, fig. 2.)

Two specimens from Apia. Life colors of one of these, black with 7 irregular stripes of pale golden yellow; fins all dull reddish, the first dorsal dusky, the rest pale.

POGONOPERCA Günther.

581. **Pogonoperca ocellata** Günther. Tahiti; Misol; East Indies.

PHAROPTERYX Rüppell.

Plesiops Cuvier, Règne Animal, II, 266, 1817, repeated in 2d ed., 1828. (No type; no species known at that time.)

Plesiops Oken, Isis, 1182, 1817; name only, after Cuvier.

Pharopteryx Rüppell, Atlas, 15, 1828 (*nigricans*).

Plesiops Günther, Cat., III, 363, 1861 (*nigricans*).

The name *Plesiops*, without specified type or reference to any species, no species of the genus having been described at the time, should apparently give place to *Pharopteryx*.

582. **Pharopteryx nigricans** Rüppell. Samoa; Tahiti; Tonga; Palau Is.; Gilbert Is.; Fiji; Solomon Is. (Seale.)

Pharopteryx nigricans Rüppell, Atlas, 15, pl. IV, fig. 2, 1828, **Red Sea.**

Plesiops nigricans Rüppell, N. W. Fische, 5, 1835. Bleeker, Atlas Ich., IX, tab. CCCXC, fig. 3. Günther, Cat., III, 363, Red Sea.

Plesiops cæruleolineatus Rüppell, N. W. Fische, 5, 1835. **Red Sea.**

Plesiops corallicola Bleeker, Nat. Tijds. Ned. Ind., IV, 1853, 280 Gunther, Fische der Südsee, 87, taf. 58, fig. B, Tahiti, Tonga, Palau, Gilbert Is.

Plesiops nigricans Boulenger, Cat., I, 340, Zanzibar, Ceylon, China, Andamans, Sumatra, Fiji, Tonga, Samoa Micronesia.

This species is very abundant in the reefs of Apia and Pago Pago. About 100 specimens were taken in the tide pools. Life colors of a specimen from Apia, black; head with sky-blue spots; a black ocellus on opercle, with orange below it; fins all black; dorsal and caudal edged with white; pectoral broadly edged with scarlet. Some (male) with sky blue spots in center of opercular ocellus, and a sky-blue stripe along middle of dorsal and anal. Some with blue spots along whole of body.

583. Pharopteryx melas (Bleeker). Samoa; Savay; Kandavu; East Indies. (Pl. XXXVIII, fig. 3.)

Plesiops melas Bleeker, Ball, 1849, 9, **Bali.**
Plesiops nigricans var. *apoda* Kner, Sitz. Ak. Wiss. Wien 1868, 54, **Savay, Kandavu.**

This species is very common in the tide pools on the reefs of Upolu and Tutuila. It is almost as common as *Pharopteryx nigricans*, but it never reaches as large a size as that species. About 60 specimens were taken. In life it is well distinguished by the broad scarlet edge of the spinous dorsal fin. The body is without blue spots or lines and there are always 11 dorsal spines, while 12 are present in all our specimens of *P. nigricans*. This leaves no doubt that *P. apoda* of Kner, based on a specimen which had lost the ventral fins, is our species, but fortunately the well-chosen name given by Bleeker is earlier.

Bleeker's description of *Plesiops melas* evidently belongs to this species, and not to *Pharopteryx nigricans*. He finds XI, 8 dorsal rays, and the color is diagnostic: "Corpore pinnisque omnibus nigerrimo maculis vel vittis nulla; membrana pinnæ dorsalis spinosæ partæ superiore tantum pellucida." This clear margin to the dorsal is, however, in life flame red.

Life colors of a specimen from Pago Pago, dark, blackish brown to black; the whitish sides finely spotted with black; dorsal with bright brick-red margin, then clear white, then broad dark-brown base, with blue line and posteriorly several short blue linear spots; caudal with orange-yellow submarginal band; blue lines in anal; ventral and pectoral pale smoky. In some specimens the caudal is black, or has a dull orange intramarginal band.

Another specimen from the same locality was black, first dorsal scarlet, edged with blue stripes on black below.

A specimen from Apia was black, iris and edge of dorsal spines scarlet; no opercular spot.

A third specimen from Pago Pago was all black, no ocellus; first dorsal edged with scarlet, a white line below it; second dorsal and caudal not pale-edged; pectoral all black.

GRAMMATONOTUS Gilbert.

584. Grammatonotus laysanus Gilbert. Laysan.

Family PRIACANTHIDÆ.

PRIACANTHUS Cuvier. (*Abuhamrur* Forskål.)

585. Priacanthus cruentatus (Lacépède). *Mata-pula.* Hawaii; Samoa; Tahiti; Caroline Is.; Japan; West Indies; Clarion Is.

This species is common throughout the Pacific. It is rather common at Apia, where about a dozen specimens were taken. It is also found at Hawaii.

Life colors of a specimen from Apia, bright light red, silvery on sides; fins much the same; dorsal, anal, and caudal with small round spots of deep red.

586. Priacanthus alalaua Jordan & Evermann. Hawaii.

587. Priacanthus hamruhr (Forskål). New Guinea (Macleay); Solomon Is. (Seale); Japan; East Indies.

588. Priacanthus meeki Jenkins. Hawaii.

Family LUTIANIDÆ.

LUTIANUS Bloch. (*Hobar* Forskål.)

589. Lutianus kasmira (Forskål). Tahiti; Samoa; Fiji; Louisiades; New Ireland; Guam; Marcus I.; New Hebrides (Seale); East Indies.

(*Holocentrus bengalensis* Bloch.)

Two small specimens of this very widely distributed species were taken at Pago Pago. Life colors of one of these, bright light golden olive with four bright blue stripes, darker edge; fins like the body, paler at base; edge of spinous dorsal deep golden.

590. Lutianus cæruleolineatus (Rüppell). Marcus I. (Bryan & Herre); New Guinea (Macleay); East Indies.

Mesoprion quinquelineatus Cuvier & Valenciennes, Hist. Nat. Poiss., ii, 445; not of Bloch.

591. Lutianus gibbus (Forskål). *Ti'ava; Mala'i; Mala'i pa'pae.* Samoa; New Britain; Tahiti; New Ireland; Waigiu; Papua; Borabora (as *Mesoprion borensis* Cuvier & Valenciennes); Solomon Is. and New Hebrides (Seale); East Indies.

(*Holocentrus boutton* Lacépède; *Diacope bottonensis* Cuvier & Valenciennes.)

Ten large examples were taken at Apia and Pago Pago. The species is easily known by the deep notch on the preopercle.

Life colors of a specimen from Pago Pago, dark olive green, the belly bright coppery red; each scale with a fine pale blue-green spot, these forming continuous lines; head mostly coppery red; caudal peduncle abruptly (obliquely) black behind dorsal; dorsal dark brown, the soft fin with white edge, the soft rays black at base; caudal black at base, golden at tip, with a maroon stripe in each lobe; anal coppery red with a black submarginal shade and a white edge; ventral coppery red, with blackish shade; pectoral pale orange, the axil black.

A specimen from Apia was olive above, very bright coppery red below; faint pale streaks along rows of scales; dorsal coppery red, dusky shaded at base, the edge yellow; anal dusky red, edged with whitish; ventral similar to anal; pectoral light orange-red.

592. Lutianus bohar (Forskål). *Mumea.* Samoa; Tahiti; Paumotus; Solomon Is. (Seale); New Guinea (Macleay); Marcus I. (Bryan & Herre); Thornton I. (Fowler); East Indies.

Two large examples were obtained at Pago Pago. This fish has the reputation of being always poisonous, the only species not Plectognath of which this statement is made. The two round pale spots below the dorsal fin are diagnostic.

Life colors, deep brick red everywhere, blackish on back, each scale with a whitish vertical spot, these forming lines along the rows of scales which are very oblique above lateral line, horizontal below; a dark dash along maxillary and behind it (in one specimen only); two rounded pale blotches along base of soft dorsal; dorsal blackish maroon, a narrow pale edge; caudal dark maroon, a narrow dark edge (the lower lobe longest, the fin deeply forked); anal darker red in front, with pale edge; pectoral deep red above and in axil, pale below; ventral mesially blackish red, pale edge. Dorsal x, 13; anal iii, 8; scales 8–64; canines large.

593. Lutianus bidens (Macleay). New Guinea.

Genyoroge bidens Macleay, Proc. Linn. Soc. N. S. W. 1883, 230, New Guinea.

594. Lutianus argentimaculatus (Forskål). *A'a; Nanue.* Samoa; Kingsmill I.; New Britain; New Guinea (Macleay).

Mesoprion garretti Günther, Fische der Südsee, 1873, 15, taf. 13, fig. B, Kingsmill I.

Of this species four fine specimens were taken at Apia. The largest, known as *a'a*, is nearly 2 feet in length. Two others still much larger were seen but not taken. The species bears a strong superficial resemblance to *Lutianus griseus* of the Atlantic.

Life colors of a specimen from Apia, olive, flushed with very dark coppery red; belly dark coppery red; a narrow blue streak below eye; fins all deep coppery red; ventral and anal black towards edge with pale anterior margin; caudal with a narrow black margin.

Another specimen from Apia, called *ganue*, had the colors of *Lutianus griseus*, the Atlantic species—dull green, scales darker in center; lower parts, with all fins, more or less coppery red; anal pale-edged; a blue streak below eye.

595. Lutianus olivaceus (Cuvier & Valenciennes). Waigiu. Perhaps same as preceding.

596. Lutianus roseus (Cuvier & Valenciennes). Ulea, Caroline Is.

Based on a drawing, a very doubtful species. Red; dorsal xiii, 12, with blue spots. It also is probably identical with *Lutianus argentimaculatus*.

597. Lutianus rivulatus (Cuvier & Valenciennes). *Uini; Nanue.* Samoa; East Indies.

Of this well-marked species two fine specimens were taken at Apia. Life colors of one called *lanue*, dark olive, each scale with a blue spot; belly coppery with blue stripes; head closely covered with wavy streaks of bright blue; dorsal greenish yellow; caudal same, dusky toward tip, with dusky edge; pectoral dusky, with pale edge; anal golden, the first soft rays dusky with narrow pale edge.

A specimen called *vi'ui* was clear olive green, bronze-orange on belly; each scale above with a small round pale-blue spot; head brassy yellow, entirely covered with light clear-blue streaks and vermiculations; maxillary yellow; fins all soiled yellow, brightest on edge.

598. Lutianus marginatus Cuvier & Valenciennes. *Taiva; Tagau; Tamala; Lanue; Nanue.* Samoa; Tahiti; Louisiades; Vanicolo; Oualan; Thornton I.; New Hebrides and Shortland I. (Seale).

Of this species, by far the most abundant of the genus, about 40 specimens were preserved—from Apia and Pago Pago. Life colors were noted in various specimens as follows:

(1) Specimen from Apia called *taiva.* Olive above, each scale edged with brassy, the belly gradually shaded to brassy orange; lower parts of head bright coppery; front of head dusky purplish, brassy about eye; dorsal blood-red, paler at base, a narrow pale edge; caudal deep wine-color with a pale edge; anal bright golden, the first soft rays darker; ventral pure golden, the first rays paler, the last duller; pectoral golden, the lower rays paler.

(2) Specimen called *tagau*, from Apia. Golden olive; yellow below; lower side of head marbled bluish gray and coppery red; dorsal scarlet, darker above, with a blackish stripe lengthwise and a whitish edge; caudal deep wine-red with whitish edge; pectoral and ventral golden; anal yellow with blackish and whitish edges.

(3) Specimen called *tamala*, from Apia. Brassy orange, bright on belly, coppery on lower part of head, dusky greenish shaded on back; head bright scarlet below with blue streaks about sub- and interopercle; dorsal scarlet with a broad black band and white edge; caudal dark wine-color, pale-edged; anal golden, darker anteriorly, and pale edged; ventral deep golden; pectoral light yellow.

(4) Also called *tamala*, from Apia. Coppery red, rather pale, greenish above; each scale edged with coppery; head deep coppery red, paler creamy red below with grayish shades; lower jaw gray; no black spot; belly yellow; dorsal blackish red, very deep paler below; soft dorsal with pale edging; caudal blackish red, edge paler; anal golden, deeper yellow anteriorly; ventral golden; pectoral transparent olivaceous.

(5) Young specimen from Apia. Very pale olive, the sides silvery gray, unmarked, the lower parts golden shaded; lower parts of head with blue and golden markings; dorsal fin pale at base, with broad edging of maroon black, and a narrow white margin; caudal grayish; dark maroon distally, with a white margin; lower fins all clear golden.

(6) From Apia. Olive green, belly orange, no spot; lower part of head scarlet over whitish; dorsal red, first with pale middle; soft dorsal dark-edged; caudal deep wine color, with white edge; ventral and anal golden; pectoral yellowish.

599. Lutianus unicolor (Alleyne & Macleay). Percy I.; New Guinea.

Genyoroge unicolor Alleyne & Macleay, Proc. Linn. Soc. N. S. W. 1876, 266.

600. Lutianus semicinctus (Quoy & Gaimard). Waigiu; Rawak; New Guinea (Macleay); Kingsmill I.; Fiji; East Indies.

601. Lutianus fulvus Forster. Tahiti; Guam.

602. Lutianus rufolineatus (Cuvier & Valenciennes). Fiji; Waigiu; Papua; East Indies.

Diacope rufolineata Cuvier & Valenciennes, Hist. Nat. Poiss., VI, 531, 1830, **Papua.**
Diacope vitianus Hombron & Jacquinot, Voy. Pole Sud, 37, taf. 2, fig. 2, **Fiji.**
Mesoprion amboinensis Bleeker, Nat. Tijds. Ned. Ind., III, 259, **Amboina.**
Mesoprion melanospilos Bleeker, op. cit., 750, **Celebes.**

603. Lutianus goldiei (Macleay). New Guinea.

Mesoprion goldiei Macleay, Proc. Linn. Soc. N. S. W. 1883, 233, **New Guinea.**

604. Lutianus parvidens (Macleay). New Guinea. (Macleay, op. cit., 234.)

605. Lutianus caudalis Cuvier & Valenciennes. Vanicolo.

606. Lutianus waigiensis (Cuvier & Valenciennes). Waigiu; North Australia.

607. Lutianus marginipinnis (Macleay). New Guinea.

Mesoprion marginipinnis Macleay, Proc. Linn. Soc. N. S. W. 1883, 254, **Normanby I. (New Guinea).**

608. Lutianus sexfasciatus (Macleay). New Guinea.

609. Lutianus rubens (Macleay). New Guinea.

Mesoprion rubens Macleay, Proc. Linn. Soc. N. S. W. 1883, 232, **New Guinea.**

610. Lutianus flavipes (Cuvier & Valenciennes). Vanicolo; East Indies.

Diacope analis Cuvier & Valenciennes, Hist. Nat. Poiss., VI, 534, 1830, **Ile de France.**
Diacope aurantiaca Cuvier & Valenciennes, op. cit., VI, 535, 1830, **Vanicolo.**

611. Lutianus lineatus (Quoy & Gaimard). Samoa; Waigiu; Guam; Christmas I.; East Indies.

Serranus limbatus Cuvier & Valenciennes, Hist. Nat. Poiss., II, 307, 1828, **Guam.**

Of this species we have 3 young specimens from the reef at Apia. They are reddish olive in spirits, with about 6 yellowish stripes from the snout to base of caudal; dorsal dark-edged; caudal dusky behind; notch on preopercle slight; tongue with teeth.

612. Lutianus vitta (Quoy & Gaimard). Waigiu; Louisiades; East Indies.

613. Lutianus chrysotænia (Bleeker). New Guinea (Macleay); East Indies.

614. Lutianus johni (Bloch). Tahiti (Günther); East Indies.

615. Lutianus fulviflamma (Forskål). Fiji; New Guinea (Macleay); Faté (Seale); East Indies.

616. Lutianus monostigma (Cuvier & Valenciennes). *Taiva uliuli; Vara sui; Feloitega;* Samoa; Tahiti; Kingsmill I.; Paumotu Is.; New Guinea (Macleay); Tubuai; Marquesas Is. and Faté (Seale).

Mesoprion monostigma Cuvier & Valenciennes, Hist. Nat. Poiss., II, 446, 1828.
Lutianus lioglossus Bleeker, Atlas, VIII, 70, tab. XLVI, fig. 4, 1877.

Of this well-marked species 12 fine specimens were taken at Apia. Life colors were noted in various specimens as follows:

(1) Specimen from Apia called *vara sui.* Olive-green, scales on sides brassy; belly whitish tinged with golden yellow; a small, well-defined black lateral spot; fins all golden-yellow; lips orange-red; no stripe on head; axil dark.

(2) Specimen called *feloitega*, from Apia. Color the same as in no. 1, with black axil spot, except that lower parts are shaded with coppery red; jaws bright red; fins all deep yellow; seems same except for red color.

(3) From Apia. Coppery red, the belly paler red, the back olive; a small jet-black lateral spot; fins all bright orange yellow, the dorsal dark on edge, the soft dorsal paler; a pale streak below eye.

(4) Specimen called *taiva uli'uli*, from Pago Pago. Dull olive-green, without red shades; lateral spot distinct; fins above yellow olive; below more yellow, verging on orange; soft dorsal, anal, and ventral with pale edge; traces of bronze streaks along scales.

This species, often poisonous, is well distinguished by its small, well-defined lateral spot and the absence of teeth on the tongue. It is well represented in Günther's plate (Fische der Südsee, pl. 16), except that in that plate the first soft ray of the dorsal is represented as a spine. In our judgment, Günther and Sauvage are right in identifying the *monostigma* of Cuvier & Valenciennes with Bleeker's *lioglossus.*

617. Lutianus erythropterus (Bloch). Guam; East Indies.

(*Diacope lineolata* Rüppell.)

618. Lutianus russelli (Bleeker). Solomon Is. (Seale); East Indies.

619. Lutianus flaviroseus (De Vis). New Britain.

This species is unknown to us. It bears some resemblance to *Lutianus monostigma*, but has a faint dark spot at base of caudal.

620. Lutianus ehrenbergi (Peters). New Ireland; New Britain; East Indies.

Mesoprion ehrenbergi Peters, Berl. Mon. 1869, 704, **New Ireland, New Britain.**

621. Lutianus aureovittatus (Macleay). Solomon Is.

This species is unknown to us. There is a large black blotch on the lateral line, and three golden stripes along the lower part of the side.

622. **Lutianus adeti** (Castelnau). New Caledonia.
Diacopus adeti Castelnau, Proc. Zool. Soc. Victoria, III, 1873, **New Caledonia.**

623. **Lutianus fuscescens** (Cuvier & Valenciennes). Tahiti (Seale); East Indies; China.

624. **Lutianus niger** (Forskål). Samoa (Günther); Papua; East Indies.
(*Mesoprion macolor* Cuvier & Valenciennes.)

This strongly marked species, the type of Bleeker's genus *Macolor*, recorded from Samoa by Dr. Günther (Fische der Südsee, p. 11) was not taken by us.

APRION Cuvier.

625. **Aprion virescens** (Cuvier & Valenciennes). Hawaii; Fiji; Tahiti; East Indies.

626. **Aprion microdon** Steindachner.

627. **Aprion latifrons** Kner. Fiji.
Sparopsis latifrons Kner, Sitz. Ak. Wiss. Wien 1868, 27, **Fiji.**

ETELIS Cuvier.

628. **Etelis evurus** Jordan & Evermann. Hawaii.

629. **Etelis marshi** Jenkins. Hawaii.

CHÆTOPTERUS Schlegel.

630. **Chætopterus dubius** Günther. Hawaii; Japan.
(*Bowersia ulaula* Jordan & Evermann.)

ROOSEVELTIA Jordan & Evermann, new genus.

Rooseveltia Jordan & Evermann, new genus of Serranidæ (*Serranus brighami* Seale).

631. **Rooseveltia brighami** (Seale). Hawaii.

632. **Rooseveltia aloha** (Jordan & Snyder). Hawaii.

BOWERSIA Jordan & Evermann.

633. **Bowersia violescens** Jordan & Evermann. Hawaii.
(*Apsilus microdon* Jordan & Evermann; not *Aprion microdon* Steindachner.)

APHAREUS Cuvier.

634. **Aphareus furcatus** (Lacépède). Tahiti; East Indies; Japan.

635. **Aphareus flavivultus** Jenkins. Hawaii.

SYMPHORUS Günther.

636. **Symphorus spilurus** Günther. Palau Is.
Symphorus spilurus Günther, Fische der Südsee, 61, taf. 47, 1873, **Palau Is.**

NEMIPTERUS Swainson. (*Synagris* Günther.)

637. **Nemipterus ruber** (Cuvier & Valenciennes). New Guinea; East Indies.

638. **Nemipterus tolu** (Cuvier & Valenciennes). New Guinea (Bleeker); Java.

639. **Nemipterus waigiensis** (Quoy & Gaimard). Waigiu; Rawak.

640. **Nemipterus marginatus** (Cuvier & Valenciennes). New Guinea; East Indies.

641. **Nemipterus tænionpterus** (Cuvier & Valenciennes). New Guinea (Ogilby); Australia; India.
Dentex tæniopterus Cuvier & Valenciennes, Hist. Nat. Poiss., VI, 246, 1830, no locality.
Synagris notatus Day, Proc. Zool. Soc. 1870, 684, **India.**

642. **Nemipterus furcosus** (Cuvier & Valenciennes). New Guinea (Macleay); East Indies.

CÆSIO Cuvier.

643. **Cæsio cærulaureus** (Lacépède). Samoa; New Guinea; Solomon Is. (Seale); East Indies.

This beautiful little fish is rather common in the coral reefs, about a dozen specimens being taken at Apia. Life colors of one of these, clear light blue, very bright; a golden streak above eye and above lateral line to base of caudal; dorsal dusky gray; caudal pink, with a black stripe along each lobe; anal pinkish; ventral white; pectoral colorless, a black bar at base; a brownish mark behind eye.

644. **Cæsio erythrogaster** Cuvier & Valenciennes. New Guinea (Macleay).

645. **Cæsio lunaris** Ehrenberg. New Ireland; New Guinea (Macleay); Solomon Is. (Seale).

646. **Cæsio chrysozonus** Kuhl & Van Hasselt. New Guinea (Macleay); East Indies.

647. **Cæsio argenteus** (Bloch). Gilbert Is. (Günther); East Indies.

648. **Cæsio pisang** Bleeker. New Guinea (Macleay).

PTEROCÆSIO Bleeker.

649. **Pterocæsio tile** (Cuvier & Valenciennes). Caroline Is.; Gilbert Is.; Tahiti; Tonga.

Family MÆNIDÆ.

ERYTHRICHTHYS Schlegel.

650. **Erythrichthys schlegeli** (Günther). Hawaii; Japan.

TERAPON Cuvier.

(*Djabub* Forskål; *Therapon* Cuvier & Valenciennes.)

651. **Terapon jarbua** (Forskål). *'Ava'ava*. Samoa; Fiji; New Britain; New Guinea; Solomon Is. (Seale).

(*Holocentrus servus* Bloch.)

This species is exceedingly common in tide waters at the river mouths in Samoa. We have about 40 specimens from the mouth of the Vaisigono River. It takes the hook readily.

Life colors of a specimen from Apia, greenish gray, bands olive brown, those in caudal browner; first dorsal gray and olive; second dorsal, ventral, and anal creamy orange. Adults have the markings more faint.

652. **Terapon nasutus** Macleay. New Guinea.

Therapon nasutus Macleay, Proc. Linn. Soc. N. S. W. 1884, 258, **Normanby I. (New Guinea).**

653. **Terapon interruptus** Macleay. New Guinea.

654. **Terapon chalybæus** Macleay. New Guinea.

655. **Terapon trimaculatus** Macleay. Goldie River, New Guinea.

656. **Terapon caudavittatus** (Richardson). New Guinea (Macleay); Australia.

657. **Terapon sexlineatus** (Quoy & Gaimard). New Guinea; Australia; Timor.

658. **Terapon oxyrhynchus** Schlegel. Fiji (Günther); Japan.

659. **Terapon puta** Cuvier & Valenciennes. New Britain; East Indies.

Therapon trivittatus De Vis, Proc. Linn. Soc. N. S. W., VIII, 457, **New Britain.**

660. **Terapon argenteus** (Cuvier & Valenciennes). Kandavu, Fiji (Kner).

Therapon argenteus Kner, Sitz. Ak. Wiss. Wien, 1868, 7, **Kandavu.**

661. **Terapon unicolor** Günther. Kandavu, Fiji (Kner); Australia.

662. **Terapon theraps** Cuvier & Valenciennes. Caroline Is. (Günther); East Indies.

Family HÆMULIDÆ.

PLECTORHYNCHUS Lacépède. (*Gaterin* Forskål.)

Fowler separates from *Plectorhynchus* the species with large scales and 14 dorsal spines as *Euelatichthys*, and those with small scales and 10 dorsal spines as *Spilotichthys*. In *Plectorhynchus* (=*Diagramma*) the scales are small and the dorsal spines mostly 12 (11 to 13). Further structural differences have been noted by Waite and Ogilby (ms.).

663. Plectorhynchus diagramma (Lacépède). *'Ava'ava moana.* Samoa; Waigiu; Tahiti; New Guinea (Macleay).

(*Diagramma lessoni* Cuvier & Valenciennes; *Diagramma lineatum* Cuvier & Valenciennes; *Plectorhynchus cuvieri* Bleeker.)

Of this strongly marked species we have two specimens from Apia and Pago Pago. In one, about nine inches long, the pale color is yellowish, the two median bands on the side coalescing over the pectoral, and the dorsal and caudal fin being marked with black stripes and no spots; the pectoral fin has a large black median spot. This specimen corresponds closely with the original figure of *P. cuvieri* as given by Bennett.

The other specimen is nearly two feet long. The pale markings are bluish gray, the stripes on the side are all distinct, and the stripes on the dorsal and caudal are broken up into large round spots, those on the caudal forming two cross-series. The pectoral fin is unspotted. This corresponds to the figures of *Plectorhynchus lessoni* as given by Lesson, Günther, and Bleeker. Bleeker's figure of *Plectorhynchus cuvieri* represents an intermediate stage. We have no doubt that these specimens belong to one species, for which the tenable name is *Plectorhynchus diagramma*.

Life colors, young specimen from Apia, dark brown, belly white, side with five pure white stripes of varying width with deep brown interspaces; head anteriorly washed with golden, the stripes becoming yellow; dorsal striped, dark brown and light yellow; caudal redder brown and deep yellow in elaborate stripes; anal yellow with two brown red stripes; ventral golden with dark spots, its axil deep red; pectoral with a brown-red axil and basal bar, the fin yellow with a large black spot.

The Pago Pago specimen, adult, had eight dark brown longitudinal stripes on side (the eighth weak); caudal bright yellow with about 30 subcircular brown blotches and margin dark brown; dorsal yellowish like tail, with black brown margin and blotches; anal same; pectoral yellow with red axil; ventrals yellow with red axil and brown markings on posterior aspect; ground-color of body white with slight bluish tinge; the white interspaces on back strongly tinged with yellow.

664. Plectorhynchus orientalis (Bloch). Samoa (Günther); East Indies.

Not found by us; perhaps representing a stage in growth of *P. diagramma*.

665. Plectorhynchus pica (Cuvier & Valenciennes). Tahiti; Fiji.

666. Plectorhynchus radja Bleeker. New Guinea (Macleay).

667. Plectorhynchus polytænia Bleeker. New Guinea (Macleay).

668. Plectorhynchus punctatissimus (Playfair). Tahiti; Seychelles.

Diagramma punctatissimum Playfair, Proc. Zool. Soc. 1867, 851, **Seychelles.** Günther, Fische der Südsee, 27, taf. 21, Society Is., on a figure of Garrett.

669. Plectorhynchus giganteus (Günther). Ponape; Caroline Is.

Diagramma giganteum Günther. Ann. Mag. Nat. Hist. 1879, 6, **Ponape.**

670. Plectorhynchus chætodonoides Lacépède. *I'a mai-moana.* Samoa; Fiji (Günther); East Indies.

(*Diagramma pardalis* Kuhl & Van Hasselt; adult.)

One very large example, closely resembling the figure of the adult given by Dr. Bleeker, was taken at Apia. Life colors, olive, closely covered above with hexagonal spots of dark brown, restricting the pale olive-green ground color to reticulations; belly slate-color; all the fins spotted like the body, the spots smaller, the pectoral spotted only on the inside; caudal with a gray and then a black margin; membrane of jaws, inside of mouth, and the naked skin at opercular joints all bright blood-red.

671. Plectorhynchus papuensis (Macleay). New Guinea.

Diagramma papuensis Macleay, Proc. Linn. Soc. N. S. W. 1883, 237.

672. Plectorhynchus hæmatochir (Bleeker). New Guinea (Macleay); East Indies.

(*Plectorhynchus goldmanni* Bleeker.)

SPILOTICHTHYS Fowler.

673. Spilotichthys centurio (Cuvier & Valenciennes). New Guinea (Macleay); Seychelles.

674. Spilotichthys pictus (Thunberg). New Guinea (Bleeker); Fiji (Günther); East Indies; Japan.

EUELATICHTHYS Fowler.

675. Euelatichthys crassispinus (Rüppell). *Misimisi.* Samoa; East Indies.

Diagramma crassispinum Rüppell, Neue Wirbelthiere, Fische, 125, taf. 30, fig. 4, 1835, **Red Sea.** Günther, Cat., I, 319.

Diagramma gibbosus Hombron & Jacquinot, Voy. Sud Pole, 46, pl. 5, fig. 5, 1854. Günther, Cat., I, 319. Günther, Fische der Südsee, 26.

Diagramma affine Günther, Cat., I, 319, **Australia, Moluccas, Amboina, Madras, China.**

Of this species we have three large examples and one small one from Apia. The small specimen has the caudal fin gray. In the others this fin is black. The small specimen and two of the large ones have the soft dorsal covered with small blackish spots. Some of these spots are seen on the caudal fin. In one specimen there are no distinct spots on the dorsal, and one faint one only at base of caudal. These specimens certainly belong to the same species, and we see no reason for separating the nominal species *affine* and *gibbosus* from it, although *P. gibbosus*, originally described from Samoa, is said to have 13 spines. This may be an individual variation or an error in counting.

Life colors of a specimen from river mouth at Apia, blackish; caudal abruptly pale gray; round black spots on dorsal, anal, and base of caudal; body unspotted; fins else blackish.

Another specimen from Apia, called *misi misi*, was dark olive, each scale with darker edge; preopercle and opercle black-edged; fins all plain dusky, the edges blacker; a few small black spots on second dorsal; no red or yellow.

676. Euelatichthys crassilabris (Alleyne & Macleay). New Guinea.

Diagramma crassilabris Alleyne & Macleay, Proc. Linn. Soc. N. S. W. 1876, 271, **Hall Sound (New Guinea).**

This species must be very close to *P. crassispinus.*

677. Euelatichthys obscurus (Günther). Fiji.

Diagramma obscurum Günther, Proc. Zool. Soc. 1871, 657, **Fiji.**

This species is not known to us. It resembles *P. crassispinus*, but the second anal spine is much smaller than in the latter.

678. Euelatichthys unicolor (Macleay). New Guinea.

Diagramma unicolor Macleay, Proc. Linn. Soc. N. S. W. 1876, 261, **China Straits, New Guinea.**

POMADASIS Lacépède 1804.

679. Pomadasis hasta (Bloch). New Britain (Peters); East Indies; New Guinea (Macleay).

SYMPHYSANODON Bleeker.

680. Symphysanodon typus Bleeker. New Guinea.

Symphysanodon typus Bleeker, Arch. Neerl. Ind. 1878, 61

SCOLOPSIS Cuvier. (*Ghanan* Forskål.)

681. Scolopsis trilineata Kner. *Taiva tusi.* Samoa; Fiji; New Guinea; New Hebrides (Seale).

Scolopsis trilineata Kner, Sitz. Ak. Wiss. Wien 1868, 301, **Samoa.** Gunther, Fische der Sudsee, 31, taf. 25, fig. A, Samoa, Fiji.

This species is one of the most tastefully colored of the coral-reef fishes of Samoa. About 20 specimens were obtained at Apia and Pago Pago.

Life colors of a specimen from Apia called *taiva tusi*, pearl-gray, darker on back; forehead very dark brown, crossed by two bright blue stripes, both of which become golden yellow on eye, which is crossed by a dark brown stripe; three pearly white stripes behind eye, the middle one fainter, uniting near middle of body and proceeding to last ray of dorsal; fins pinkish gray; dorsal narrowly edged with orange; anal with pale blue; anal and soft dorsal with some orange shading; lower half of belly and head pure white.

682. Scolopsis bilineata (Bloch). New Guinea (Macleay); Kandavu, Fiji (Kner); Shortland I. (Seale); East Indies; Ovalau and Levuka (Günther).

683. Scolopsis lineata (Quoy & Gaimard). Guam; Samoa (Günther); Faté (Seale).

684. Scolopsis ciliata (Lacépède). Vanicolo; New Guinea (Macleay); East Indies.

685. Scolopsis monogramma Kuhl & Van Hasselt. New Guinea (Macleay); Faté and New Hebrides (Seale); East Indies.

686. Scolopsis temporalis Cuvier & Valenciennes. New Guinea (Macleay); Fiji (Günther); Vanicolo; Waigiu; Louisiades; Solomon Is. (Seale).

687. Scolopsis xenochrous Günther. Misol.

Scolopsis xenochrous Günther, Cruise of the Curaçoa, 1873, 20.

688. Scolopsis cancellata Cuvier & Valenciennes. Polynesia; New Hanover (Peters); East Indies.

689. Scolopsis margaritifera Cuvier & Valenciennes. New Guinea (Macleay); East Indies.

690. Scolopsis affinis Peters. New Ireland; New Britain.

Scolopsis affinis Peters, Berl. Mon., 1876, 832, **New Britain, New Ireland.**

691. Scolopsis macrophthalmus Ramsay & Ogilby. New Guinea.

PENTAPUS Cuvier & Valenciennes.

692. Pentapus caninus Cuvier & Valenciennes. New Guinea (Macleay); Louisiades; Apamana; Gilbert Is. (Günther).

693. Pentapus vittatus (Bloch). New Guinea (Günther); Solomon Is. (Seale); East Indies.

GNATHODENTEX Bleeker.

694. Gnathodentex aurolineatus (Lacépède). *Tolai.* Samoa; Hervey Islands; Tonga; Gilbert Is.; Tahiti; Paumotu Is.; Marcus I.; New Guinea (Macleay); Tubuai and Mangareva (Seale); East Indies.

This species is common about Samoa, where about 15 specimens were taken.

Color of a specimen from Apia called *tolai*, light olive-gray; 6 to 8 very faint longitudinal stripes of brownish bronze above lateral line, all of them disappearing behind middle of body; still fainter streaks below lateral line; larger specimens with 5 broad, faint stripes of gold-bronze below lateral line; an oblong spot of light yellow below soft dorsal; fins all plain light reddish, the edges a little darker; opercular flap dark; inside of mouth orange.

Family SPARIDÆ.

LETHRINUS Cuvier. (*Schoür* Forskål, 1775.)

695. Lethrinus ramak (Forskål). *Mailafo'u; Magauli.* Samoa; Palau Is.; Kingsmill I.; Fiji, East Indies.

Sciæna ramak Forskål, Descr. Anim., 53, 1775, **Red Sea.**
Lethrinus ehrenbergii Cuvier & Valenciennes, Hist. Nat. Poiss., VI, 31, 1830, **Red Sea.**
Lethrinus flavescens Cuvier & Valenciennes, Hist. Nat. Poiss., VI, 299, 1830, **Tonga.**
Lethrinus ramak, Günther, Cat., I, 459, Red Sea, Ceylon. Günther, Fische der Sudsee, 69, taf. 46, fig. B, Samoa, Palau Is., Kingsmill, Celebes.

This species is common at Samoa. Five large specimens were secured.

Life colors of a specimen from Apia called *mailafo'u*, a faint pinkish band from pectoral back; head olive; lips flesh color; dorsal dull orange mottled with gray; caudal dull orange; anal reddish; ventral pale-yellowish tinged; pectoral faintly orange; no lateral spot.

Another specimen from Apia, called *maganli*, was light green, no spot; axil black; head dark; lips and gums scarlet; dorsal light bright red; caudal dirty yellow; pectoral bright yellow, orange above; anal dull orange; ventral gray, black at tip.

696. **Lethrinus harak** (Forskål). *Mata 'ele'ele.* Samoa; New Britain; New Hanover (Peters); Faté in the New Hebrides (Seale).

Of this species 2 large specimens were taken at Apia. Life colors of one called *mata 'ele'ele*, dull olive green; fins all brick red; inside of mouth scarlet. A black lateral spot on molar teeth.

697. **Lethrinus bonhamensis** Günther. Samoa; Bonham I.; Philippines.

Lethrinus bonhamensis Günther, Fische der Sudsee, 65, taf. 46, **Bonham I.**

A single large specimen corresponding to Günther's figure was taken at Apia. It is near *Lethrinus harak*, but is apparently distinct. We have also examined specimens of the same species in the U. S. National Museum, collected on Negros Island in the Philippines by Prof. Bashford Dean.

698. **Lethrinus papuensis** Alleyne & Macleay. New Guinea.

699. **Lethrinus amboinensis** Bleeker. Samoa; Palau Is. (Günther); East Indies.

Of this species we have 1 specimen from Apia.

700. **Lethrinus erythropterus** Cuvier & Valenciennes. Ulea.

701. **Lethrinus chrysostomus** Richardson. New Guinea (Alleyne & Macleay); Australia.

702. **Lethrinus nebulosus** (Forskål). Fiji (Günther); East Indies.

703. **Lethrinus mahsena** (Forskål). Samoa; Fiji; Palau Is.; Paumotu Is.; Waigiu; Mangareva (Seale).

(*Lethrinus hypselopterous* Bleeker.)

Of this species we have 1 large example from Apia, corresponding to Günther's figure, and almost equally well to Bleeker's plate of *Lethrinus hypselopterus*.

704. **Lethrinus mahsenoides** Bleeker. New Guinea (Ramsay & Ogilby); East Indies.

705. **Lethrinus alboguttatus** Cuvier & Valenciennes. Bonin Is.

706. **Lethrinus laticaudus** Alleyne & Macleay. New Guinea.

Lethrinus laticaudus Alleyne & Macleay. Proc. Linn. Soc. N. S. W. 1876, 276, **Percy I.** (**New Guinea**).

707. **Lethrinus moensi** Bleeker. Tahiti; Tonga; Fiji; Paumotu Is.; Harvey Is.; New Guinea; Palau Is.; Louisiades; Marquesas Is. (Seale); East Indies.

708. **Lethrinus ornatus** Bleeker. New Guinea (Macleay); East Indies.

709. **Lethrinus leutjanus** Lacépède. New Guinea (Macleay); Faté (Seale); East Indies.

710. **Lethrinus hæmatopterus** Bleeker. Fiji (Günther); New Guinea (Macleay); East Indies.

711. **Lethrinus erythracanthus** Cuvier & Valenciennes. Luganor; Mortlock Is.; Carolines.

712. **Lethrinus sordidus** Cuvier & Valenciennes. New Guinea.

713. **Lethrinus waigiensis** Cuvier & Valenciennes. Waigiu.

714. **Lethrinus xanthopterus** Cuvier & Valenciennes. Ulea, Caroline Islands.

715. **Lethrinus aurolineatus** Macleay. New Guinea.

Lethrinus aurolineatus Macleay, Proc. Linn. Soc. N. S. W. 1883, 247, **New Guinea.**

LETHRINELLA Fowler.

This genus is distinguished from *Lethrinus* by the elongate pike-like snout and jaws.

716. **Lethrinella miniata** (Forster). *Filoa 'ava.* Samoa; Tahiti; Louisiades; Marcus I.; New Britain; East Indies.

Of this remarkable species, distinguished by the pike-like prolongation of the snout, we have 3 large examples from Apia, one of them 2½ feet long. The long snout and comparative slenderness of the teeth define the well-marked genus *Lethrinella* of Fowler.

Life colors of a specimen called *filoa ra*, from Apia, pale grayish olive unmarked; mouth scarlet within; membrances of upper jaw red; dorsal, anal, and caudal grayish, mottled olive, edged with dull red; pectoral dull light olive, ventral dusky gray.

MONOTAXIS Bennett.

717. **Monotaxis grandoculis** (Forskål). *Mumu moaga; Loalia* (a Rarotongan word). Hawaii; Samoa; Papua; Fiji; East Indies.

This species is rather common about Samoa, as also at Hawaii. It is valued as a food fish.

Life colors of a specimen from Apia, olive green, with 2 whitish cross-bars; a black crescent at base of pectoral; dorsal brownish, reddish at tip; caudal orange, yellow at base; anal like dorsal; pectoral and ventral reddish.

718. **Monotaxis euanus** (Günther). Tonga Is.

Sphærodon euanus Günther, Ann. Mag. Nat. Hist., IV, 1879, 187, **Eua (Tonga Is.)**.

SPARUS (Artedi) Linnæus. (*Chrysophrys* Cuvier & Valenciennes.)

719. **Sparus australis** (Günther). New Hebrides; Australia.

Chrysophrys australis Günther, Cat., I, 491, **rivers of Australia.** De Vis, Proc. Linn. Soc. N. S. W, 1884, 457, Api (New Hebrides).

720. **Sparus novæ-caledoniæ** (Castelnau). New Caledonia.

Chrysophrys novæ-caledoniæ Castelnau, Proc. Zool. Soc. Vict. 1873, 110, **New Caledonia.**

721. **Sparus berda** Forskål. New Guinea (Macleay); East Indies.

(*Sparus hasta*, Bloch & Schneider.)

Family KYPHOSIDÆ.

PACHYMETOPON Günther.

722. **Pachymetopon squamosum** Alleyne & Macleay. New Guinea.

Pachymetopon squamosum Alleyne & Macleay, Proc. Linn. Soc. N. S. W. 1876, 225, **Hall Sound (New Guinea).**

KYPHOSUS Lacépède. (*Tahmel* Forskål, 1775.)

723. **Kyphosus fuscus** (Lacépède). Hawaii; New Hebrides (Seale); East Indies.

724. **Kyphosus lembus** (Cuvier & Valenciennes). Vanicolo; East Indies.

725. **Kyphosus sandvicensis** (Sauvage). Hawaii; Laysan; Marcus I. (Bryan & Herre).

This species seems to be almost identical with *Kyphosus elegans* Peters, a species from the west coast of Mexico.

726. **Kyphosus waigiensis** (Quoy & Gaimard). *Umue; Matu mutu.* Waigiu; Papua; Caroline Is.; Samoa; Palau Is.; New Guinea.

Three large specimens of this species were taken at Apia. Life color of one called *umue*, bronze brownish, with a gray spot on each scale, these forming pale bluish streaks, alternating with darker bronze streaks; no other colors; fins all dusky; pale below eye, a dark streak about it; opercle dark-edged.

727. **Kyphosus tahmel** (Forskål). New Guinea (Bleeker); East Indies.

SECTATOR Jordan & Fesler.

728. **Sectator azureus** Jordan & Evermann. Hawaii.

Family GERRIDÆ.

XYSTÆMA Jordan & Evermann.

729. Xystæma gigas (Günther). *Matu loa.* Samoa; Fiji; Tonga.

Gerres gigas Günther, Cat., IV, 262, **Tonga.** Günther, Fische der Südsee, 30, taf XXIV, fig. A, Tonga, Fiji, Samoa

Life colors of a specimen from Apia called *matu loa*, silvery with faint dark shades; no bright colors; caudal pale edged; first dorsal elevated, its edge dusky.

One large specimen and one very small one taken at Apia. Apparently this species is distinct from *X. oblongum* (Cuvier & Valenciennes) of India, with which Day unites it. *X. oblongum* is still more elongate.

730. Xystæma argyreum (Forster). *Matu.* Samoa; Tahiti; Waigiu; Strong I.; Tanna; Australia; East Indies.

(*Gerres waigiensis* Quoy & Gaimard.)

Compared with *X. argyreum*, *X. gigas* is less silvery, and has more distinct streaks along the rows of scales. In *X. gigas* the snout is longer than eye; the body is more elongate, and the head proportionately longer.

This species is more common at Samoa than *X. gigas*, but seems to reach a rather smaller size. We have 8 examples of different sizes from Apia and Pago Pago. Life colors of an example from Apia, silvery, without dark streaks; ventral and anal light yellow; other fins scarcely yellowish; edge of spinous dorsal dusky.

731. Xystæma abbreviatum (Bleeker). New Guinea (Ramsay & Ogilby); East Indies.

This can not be *Sparus erythrourus* of Bloch, which is a species of *Xystæma*, said to be from Japan. Bloch's type is more elongate, the depth being 3½ inches, the total length 10½ inches in the type in the Museum of Berlin.

732. Xystæma macrosoma (Bleeker). Samoa (Kner, Sitz. Ak. Wiss. Wien 1868, 9, Savaii); Admiralty Is. (Gunther); East Indies.

This species, recorded by Kner from Samoa, was not seen by us.

733. Xystæma punctatum (Cuvier & Valenciennes). Vanicolo; New Britain and New Hanover (Peters); East Indies.

(*Gerres filamentosus* Cuvier & Valenciennes, adult.)

Valenciennes describes *Gerres punctatus* as having the depth 3½ in the total length with caudal. This is true of the very young only (2½ inches long). In the adult it is 3 or a little less. *Gerres punctatus* is, however, evidently the same as *G. filamentosus*, and the name occurs on an earlier page of the same work.

734. Xystæma acinaces (Bleeker). New Guinea (Macleay); East Indies.

735. Xystæma poeti (Cuvier & Valenciennes). Milne Bay, New Guinea (Macleay); East Indies.

736. Xystæma macracanthum (Bleeker). New Guinea (Macleay); East Indies.

ULÆMA Jordan & Evermann.

737. Ulæma bispinosum (Alleyne & Macleay). New Guinea.

Gerres bispinosus Alleyne & Macleay, Proc. Linn. Soc. N. S. W. 1876, 273, **Hall Sound.** Anal rays II, 8.

Family EQUULIDÆ.

EQUULA Cuvier.

Equula Cuvier, Règne Anim., ed. 1, vol. II, 323, 1817 (*insidiator*).
Deveximentum Fowler, Journ. Ac. Nat. Sci. Phila. 1904, 517 (*insidiator*).

738. Equula insidiator (Bloch). Tahiti (Kner); East Indies.

This species is separated by Fowler from *Leiognathus* as the type of a distinct genus *Deveximentum*, characterized by the vertical mouth. But the same species is the original type of the genus *Equula*, which has been regarded as a synonym of *Leiognathus*.

LEIOGNATHUS Lacépède.

739. **Leiognathus fasciatus** (Lacépède). Samoa; Fiji (Günther); New Britain (Peters); East Indies.

This species is common at Samoa, numerous specimens being taken about Apia and Pago Pago in the seine.

Life colors of a specimen from Apia, spots on sides and dorsal bars dull brassy; axil brassy and brassy shades on dorsal and anal fins.

Another specimen from Apia was silvery, faintly streaked and barred above. Dorsal spine not reaching tip of last spine in specimen 3 inches long. Young.

740. **Leiognathus obscurus** (Seale). Guam.

Leiognathus obscurus Seale, Bishop Mus. 1901, 74, Guam.

741. **Leiognathus equula** (Forskål). New Caledonia; East Indies.

Equula caballa (Cuvier & Valenciennes). Castelnau, Proc. Zool. Soc. Victoria, 1873, 114, New Caledonia.

742. **Leiognathus dussumieri** (Cuvier & Valenciennes). Tahiti (Kner, Novara Fische, 167); East Indies.

743. **Leiognathus edentulus** Lacépède. New Guinea (Macleay); East Indies.

744. **Leiognathus smithursti** (Ramsay & Ogilby). New Guinea.

Equula smithursti Ramsay & Ogilby, Proc. Linn. Soc. N. S. W. 1886, 11.

GAZZA Cuvier.

745. **Gazza minuta** (Bloch). New Guinea; New Britain (Peters); Tahiti (Kner); East Indies.

746. **Gazza equulæformis** (Rüppell). Solomon Is.; East Indies.

747. **Gazza argentaria** (Forster). Tanna; New Hebrides; East Indies.

Family MULLIDÆ.

UPENEUS Cuvier. (*Upeneoides* Bleeker.)

748. **Upeneus vittatus** (Forskål). *Vete.* Tahiti; Samoa; Papua; Borabora; Fiji; Marquesas Is. (Seale); East Indies.

This species is rather common about Samoa, where about a dozen specimens were taken. In life the belly is a bright sulphur-yellow. The number of bands on the caudal fin is fewer than in *Upeneus arge*, one of those on the lower lobe being very broad and black.

Life colors of a specimen called *uete*, olive, sides silvery, no red except on iris and sides of snout, side with 5 golden bands, fourth the brightest and broadest; belly bright sulphur yellow, in a broad stripe; barbels white; first dorsal black at tip, with 2 white and 2 brassy bands, one of the latter at base; second dorsal with 4 white and 4 olive oblique bands; fourth and fifth lateral bands converging on tail; upper lobe also with 3 dark oblique bands and 4 white bands; lower with 3 white and 2 dark bands, the outer one very broad, nearly as broad as eye, and black with yellow edge, twice the width of upper outer band.

749. **Upeneus arge** Jordan & Evermann. Hawaii.

This large species is common about Hawaii, but has not been seen elsewhere. It has the belly silvery white in life and the caudal bands are more numerous and more even than in *Upeneus vittatus*.

750. **Upeneus tæniopterus** (Cuvier & Valenciennes). Hawaii (Steindachner); Ceylon.

751. **Upeneus tragula** Richardson. New Guinea (Macleay); East Indies; China.

PSEUDUPENEUS Bleeker.

(*Upeneus*, *Pseudupeneus*, and *Parupeneus*, all of Bleeker.)

752. **Pseudupeneus multifasciatus** (Quoy & Gaimard). Hawaii.

This species is very common about Hawaii, where it replaces the *P. moana* of the islands of Polynesia. In the former species the bright red area among the bands on the side is behind the pectoral. In *Pseudupeneus moana* the bright yellow area is under the soft dorsal.

753. Pseudupeneus moana Jordan & Seale, new species. *Moana; Moaga; Maga* (juv.); *Moana faiara.* Samoa.

Upeneus trifasciatus Günther, Fische der Südsee, 59, taf. XLIV, fig. B, Vavau, Samoa, Amboina; not of Lacépède.
Upeneus multifasciatus Seale, Bishop Museum, I, 71, 1901, Guam; not of Quoy & Gaimard.
Parupeneus multifasciatus Bleeker, Mulloides, 20, 1874; Atlas, Mulloides, tab. IV, fig. 4.

Head 3 in length to base of caudal; depth 3.25; eye 6.10 in head; interorbital 3.75; maxillary 3 in head, its distal width greater than eye, its posterior end not reaching below anterior margin of eye by at least two-thirds width of eye; dorsal VIII-9; anal 7; scales 2-32-6; barbels long, reaching to second row of scales in front of ventrals.

Body oblong, compressed, deepest at origin of spinous dorsal; depth of caudal peduncle 2 in its length; body and head scaled; lips wide; teeth in a single row in each jaw, no teeth on vomer or palatines; preopercle entire; a short flat opercular spine; gill-rakers slim and sharp, 25 on lower limb, the longest slightly more than one-half width of eye; only two complete rows of scales between the dorsal fins; height of spinous dorsal 1.35 in head, its base 1.90; base of soft dorsal 1.95 in head, its last ray usually elongate, reaching to base of caudal; pectoral 1.35 in head; ventral 1.20 in head; base of anal 2.50 in head; its posterior ray somewhat prolonged, 1.95 in head; caudal 1.35 in head.

Color in spirits, upper half of body brownish with wash of purple, yellowish white below; a broad saddle of black on caudal peduncle; another broad black band from anterior half of soft dorsal; between these two is a bright yellow area, about as wide as the posterior black band; a narrow black band between the two dorsals, the yellow lines bordering on its posterior and anterior margins being narrow, about one scale in width; a broad, black band from anterior two-thirds of spinous dorsal; another black band in front of spinous dorsal, making in all five black vertical bands on the sides; all of these bands fade out a little below the axis of the body; there is a dusky blotch posterior to eye extending more or less distinctly upon nuchal region; a dusky line through eye and along sides of snout; spinous dorsal dusky; soft dorsal dusky at base with yellow margin, and some 4-5 narrow intermarginal lines of alternating light and dusky; the last ray of dorsal is entirely deep black; caudal dusky, with black upper and lower margins; anal yellowish with 4 intermarginal longitudinal lines of dusky; pectoral yellow; ventral yellow, the outer rays bluish.

Life colors of a specimen from Apia, dirty purplish red mottled with black and yellow, with 4 darker cross-bands; lower side of head wine red; barbels purplish; dorsal clouded dusky; second dorsal with blue and yellow streaks at tip; caudal dirty brown, edged with black above and below; anal pale violet, and with 4 violet and 4 light yellow streaks; ventral red with a purple-black edge; pectoral bright golden orange. Adult.

Another specimen from Apia, called *moana*, was olive, with golden edges and bluish base to scales; five blackish cross-bands; a black blotch behind eye; first dorsal dusky, second golden blackish at base, streaked above with bluish; caudal golden, covered with fine bluish streaks; anal dusky; ventral dusky; pectoral yellowish; barbels golden.

This species, common in the East Indies and in the South Seas, seems never to have received a distinctive specific name. The name *trifasciatus* certainly belongs to *Pseudupeneus bifasciatus*, while that of *multifasciatus* was given to the common moana of the Hawiian Islands.

Twenty-five specimens from Apia. The type is no. 51737, U. S. National Museum, length 8.55 inches.

The species is known from Samoa, Guam, Tahiti, Vavau, New Guinea (Macleay), Mangareva, Rarotonga, New Hebrides, Tubuai, and Nukahiva (Seale); also from East Indies.

754. Pseudupeneus atrocingulatus (Kner). *Moana*; *Moaga*. Samoa (Günther); Vavau; Amboina.

Upeneus atrocingulatus Kner, XXI, 443. Günther, Fische der Südsee, 59, as var. C of *U. trifasciatus*, Samoa, Vavau, Amboina.

This species is close to *Pseudupeneus moana*, but the coloration is different from any specimen seen by us. We therefore regard it as a different species.

755. Pseudupeneus bifasciatus (Lacépède). *Matalau uliuli; Maga* (young). Hawaii; Samoa; Rarotonga; Caroline Is.; Solomon Is; Marcus I.

(*Mullus bifasciatus* and *Mullus trifasciatus* Lacépède.)

This species is common both at Hawaii and Samoa, where it reaches a large size, and is highly valued as food. It is easily distinguished from related species by the two or three broad cross-shades, one under each dorsal.

Life colors of a specimen from Apia, called *matalau uliuli*, dusky violet-brown, no red; traces of faint diffuse dusky crossbars, one under first dorsal, one under second, the third on caudal peduncle; head with faint violet and golden specks and edgings; barbels black, yellow at tip; two faint paler cross-rings, one before and one behind dark bar on caudal peduncle; fins dusky; first dorsal dull bronze with pinkish rays; second dorsal and anal dull violet, with dull yellowish cross-streaks; caudal violet-black mottled with yellowish; ventral dull violet-bronze; pectoral paler, similar; a dusky bar across its base. A younger example was a little more reddish.

Another specimen from Apia was dark brownish gray, no red; three broad blackish cross-bands, the first at front of first dorsal, second under second dorsal, third on caudal peduncle; first dorsal blackish, tinged with dark red, olive at base, the rays pale violet; soft dorsal light olive with blue lines, and a broad black edge; caudal and anal similar; ventral dull red, shaded with black, a dusky bar across base of pectoral; pectoral pale reddish; barbels yellow.

A specimen called *ouga* (young), from Apia, was dirty green, much marbled; a black bar below front of first dorsal and one below front of second dorsal; second dorsal and anal blackish, edged with pale; caudal dusky olive brown, pale-edged; ventral black, pale-edged; first dorsal brown; barbels yellow; head soiled and mottled olive.

756. Pseudupeneus semifasciatus (Macleay). New Guinea.

Upeneus semifasciatus Macleay, Proc. Linn. Soc. N. S. W. 1884, 263, **Hood Bay.**

757. Pseudupeneus porphyreus Jenkins. Hawaii.

758. Pseudupeneus chryserydros (Lacépède). *Matulau*. Samoa; Hawaii; Tahiti; Faté (Seale); East Indies.

Parupeneus xanthospilurus Bleeker, Mulloides, 57, 1874, **Amboina.**

This species is common about Samoa, as also about Hawaii. It is well distinguished by its peculiar violaceous coloration, like the lees of wine, according to Commerson, and by the golden or pale area on the back of the tail. The barbels, as in *Upeneus cyclostomus*, are elongate. There seems to be no question that Lacépède's glowing description of the "Mullus rougeor" belongs to this species.

Life colors of a specimen from Apia, very pale violet, pinkish and greenish, not nearly so dark as in Hawaii.

759. Pseudupeneus cyclostomus (Lacépède). Samoa; East Indies.

Of this species we have three large specimens from Pago Pago. The species resembles *Pseudupeneus chryserydros*, but lacks the pale saddle on the tail, while the general color is clear red without markings. The barbels, as in *Pseudupeneus chryserydros*, are long, reaching past base of ventrals. The species is well represented in Sauvage's figure of *Upeneus cyclostomus*.

760. Pseudupeneus saffordi (Seale). Guam; East Indies.

Upeneus cyclostomus Günther, Fische der Südsee, 60, 1873, **Mascarene I.**; not of Lacépède.
Upeneus chryserythrus Sauvage, Poiss. Madagascar, 228; not of Lacépède.
Upeneus saffordi Seale, Bishop Museum 1901, 72, **Guam.**

This species was not seen by us. It is apparently the *Upeneus cyclostomus* of Günther, with short barbels, reaching preopercular margin, and with a pale area on the back of the tail.

761. Pseudupeneus crassilabris (Cuvier & Valenciennes). Johnston I.; Papua.

?*Upeneus luteus* Cuvier & Valenciennes, Hist. Nat. Poiss., vii, 521, 1831, **Isle de France.**
Upeneus crassilabris Cuvier & Valenciennes, op. cit., 523, **Papua.**

762. Pseudupeneus chrysonemus Jordan & Evermann. Hawaii.

763. Pseudupeneus fraterculus (Cuvier & Valenciennes). Hawaii (Steindachner); Seychelles; Zanzibar.

764. Pseudupeneus tæniatus (Kner). Fiji; China ?.

Upeneus barberinoides Kner, Novara Fische, pl. iv, 81, **China**; not of Bleeker.
Upeneus tæniatus Kner, Sitz. Ak. Wiss. Wien 1868, 13, **Kanathia (Fiji).**
Parupeneus kneri Bleeker, Ned. Dierk., iv, 142, **China**; after Kner.

This species was not taken by us, unless it should prove to be the young of *Pseudupeneus chrysonemus*, which shows two pale lengthwise stripes on the upper anterior portion of the body in life.

765. **Pseudupeneus barberinus** (Lacépède). *Ta'uleia.* Samoa; Palau Is.; Paumotu Is.; Harvey I.; Kingsmill I.; Solomon Is.; East Indies.

This widely diffused species is rather common about Samoa, where three large examples were taken.

Life colors of a specimen from Apia, reddish gray, with bluish and yellowish streaks on head, the scales edged with bronze; a blackish brown stripe from snout through eye to last dorsal rays; a large dark brown spot at base of caudal; dorsal reddish, brown-edged in front; second dorsal and anal with obscure yellowish cross-streaks; caudal reddish, the rays yellowish; ventral and pectoral pale, tinged with yellowish; barbels white.

A larger example redder, with marks fainter.

766. **Pseudupeneus barberinoides** (Bleeker). New Guinea (Macleay); East Indies.

767. **Pseudupeneus indicus** (Shaw). *Ta'uleia; Lailai.* Samoa; Tonga; Fiji; Waigiu (as *U. waigiensis* Cuvier & Valenciennes); East Indies.

Of this species we have two large specimens from Apia. The golden spot on the side of the back and the black spot on the back of the tail are characteristic.

Life colors of a specimen from Apia, olive-green, each scale darker olive at edge; a large oblong golden yellow blotch under soft dorsal; a large black blotch before base of caudal; cheek olive, with blue streaks; dorsal olive, second dorsal faintly barred with brassy; anal pinkish, similarly barred; ventral pink; pectoral pinkish; caudal pale yellowish olive, the outer rays pink; ventral bright pink; barbels pinkish.

768. **Pseudupeneus pleurostigma** (Bennett). Hawaii; Tahiti; Gilbert Is.; East Indies.

769. **Pseudupeneus pleurospilos** (Bleeker). Shortland I.; Solomon Is. (Seale); Japan; East Indies.

770. **Pseudupeneus preorbitalis** (Smith & Swain). Johnston I.; southwest of Hawaii.

771. **Pseudupeneus filamentosus** (Macleay). New Guinea.

Upeneus filamentosus Macleay, Proc. Linn. Soc. N. S. W. 1884, 263, **Hood Bay.**

MULLOIDES Bleeker.

772. **Mulloides auriflamma** (Forskål). *Ula'oa; Vete.* Samoa; Hawaii; New Guinea; Guam; Borabora; Tubuai; Tahiti and Nukuhiva (Seale); East Indies.

? *Upeneus atherinoides* Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 526, **Guam.**

This species is abundant throughout the Pacific. We took several specimens in Pago Pago and about a dozen in Apia.

Life colors of a specimen from Apia called *ula'oa*, olive, belly silvery, flushed with red; a golden stripe, very bright, with yellow shades above and below; a black bar across base of pectoral; ventral and anal blackish yellow; caudal and both dorsals plain golden; pectoral colorless; no bars or spots.

Another specimen from Apia, light gray olive; back pinkish; opercles pink; a brownish yellow lateral band with yellow shades below; upper fins yellow; lower gray; yellow on sides of head; caudal dull yellow; barbels white.

773. **Mulloides vanicolensis** (Cuvier & Valenciennes). Vanicolo; Johnston I. (Smith & Swain).

774. **Mulloides samoensis** Günther. *Afolu; I'a sina* (white or lady fish—the young). Hawaii; Samoa.

This species is very abundant about Samoa, and scarcely less so in Hawaii. The small black spot on the side near the tip of the pectoral fin is very constant.

In one specimen from Apia there was a golden orange lateral band somewhat interrupted. Another specimen from this locality was pale, a broad deep dull yellow lateral stripe with yellow shades above and below; yellow dashes on sides of head, besides coppery; a small dark brown spot above end of pectoral in lateral shade; first dorsal anteriorly deep yellow, fading behind; second dorsal pale yellow, caudal bright yellow; lower parts, barbels and fins pure white.

The *i'a sina* is plainly the young of the *afolu*.

775. **Mulloides erythrinus** Klunzinger. Hawaii; Laysan; Tahiti; East Indies.

776. Mulloides flammeus Jordan & Evermann. Hawaii; Raiatea and Tahiti (Seale; perhaps the young of *M. pflugeri*).

777. Mulloides pflugeri Steindachner. Hawaii.

778. Mulloides zeylonicus (Cuvier & Valenciennes). New Guinea (Bleeker); Ceylon.

Family TOXOTIDÆ.

TOXOTES Cuvier.

779. Toxotes jaculatrix (Pallas). New Guinea (Macleay); Faté, New Hebrides (Seale); East Indies.

Family SILLAGINIDÆ.

SILLAGO Cuvier.

780. Sillago sihama (Forskål). Admiralty Is. (Günther); Bougainville Is. (Peters, Berl. Mon. 1876, 836); East Indies.

781. Sillago ciliata Cuvier & Valenciennes. Percy I.; New Guinea (Macleay); Australia.

782. Sillago insularis Castelnau. New Caledonia.

Sillago ciliata or *insularis* Castelnau, Proc. Zool. Soc. Vict. 1873, 113, **New Caledonia.**

783. Sillago gracilis Macleay. New Guinea.

Sillago gracilis Macleay, Proc. Linn. Soc. N. S. W. 1884, 279, **Hall Sound.**

Family MALACANTHIDÆ.

MALACANTHUS Cuvier.

784. Malacanthus parvipinnis (Vaillant & Sauvage). Hawaii.

OCEANOPS Jordan & Seale, new genus.

Oceanops Jordan & Seale, new genus of *Malacanthidæ* (*M. latovittatus* Lacépède).

785. Oceanops latovittata (Lacépède). *Gatasami.* Samoa; Palau Is.; Papua; East Indies. (Pl. XXXIX.)

This singularly beautiful fish is rather rare at Samoa. Two large specimens were taken at Pago Pago. The large size and brilliant blue coloration distinguish this species, in a very marked manner, from its dull gray-colored congeners. It has also a much longer, pike-like snout, thus unlike *Malacanthus plumieri* and *parvipinnis*. It may be held as the type of a distinct subgenus or genus—*Oceanops*—this appellation being a translation of the native name.

Life colors of a specimen from Pago Pago called *gatasami* (eye of the sea), intense violet blue; back black, with the blue reduced to streaks; jet black lateral band; belly abruptly white; dusky across base of pectoral; dorsal dusky at base, abruptly grayish above; caudal black, with a white square, bluish white stripe above, upper angle brown; anal whitish; ventral whitish; pectoral blue.

Family PSEUDOCHROMIDÆ.

PSEUDOCHROMIS Müller & Troschel.

786. Pseudochromis fuscus Muller & Troschel. Solomon Is.; Yap I.; Palau Is.; East Indies.

PSEUDOGRAMMA Bleeker.

787. Pseudogramma polyacanthus (Bleeker). Tahiti; Fiji; Marcus I.; Raiatea, East Indies.

Pseudochromis polyacanthus Bleeker, Ternate, VII. 375, 1856, **Ternate.** Kner, Sitz. Ak. Wiss. Wien 1867, 717, **Fiji** Gunther, Fische der Sudsee, 159, taf. 98, fig. A, **Tahiti, Raiatea.** Fowler, Proc. Ac. Nat. Sci. Phila. 1900, 523 **Tahiti.**

Pseudogramma polyacanthus, Bryan & Herre, Bishop Museum, vol. II, no. 1, 1903, 139, **Marcus I.**

Family CIRRHITIDÆ.

CHEILODACTYLUS Cuvier.

788. Cheilodactylus vittatus Garrett. Hawaii.

CIRRHITUS Lacépède.

789. Cirrhitus marmoratus Lacépède. *Potati.* Hawaii; Rarotonga; Samoa.

This species, very common at Hawaii, is not rare about the reefs of Samoa. Six specimens were taken at Apia.

790. Cirrhitus oxycephalus Bennett. Bonham I.; Marshall group; East Indies.

PARACIRRHITES Bleeker.

791. Paracirrhites forsteri (Cuvier & Valenciennes). Hawaii; Marquesas Is. (Seale).

792. Paracirrhites arcatus (Cuvier & Valenciennes). Hawaii; New Guinea.

793. Paracirrhites cinctus (Günther). Hawaii.

794. Paracirrhites hemistictus (Günther). Kingsmill I.; Tahiti.

Cirrhites hemistictus Günther, Fische der Südsee, 69, taf. 50, fig. B, **Kingsmill, Tahiti.**

795. Paracirrhites polystictus (Günther). Tahiti; Kingsmill I.

Cirrhites polystictus Günther, Fische der Südsee, 70, taf. 50, fig. A, **Kingsmill, Tahiti.**

796. Paracirrhites melanotus (Günther). Tahiti; Raiatea.

Cirrhites melanotus Günther, Fische der Südsee, 72, taf. 52, fig. C, 1873, **Tahiti, Raiatea.**

797. Paracirrhites punctatus (Cuvier & Valenciennes). Savaii (Kner, Sitz. Ak. Wiss. Wien 1868, 16).

This species, obtained at Samoa by Kner, was not seen by us.

CIRRHITOIDEA Jenkins.

798. Cirrhitoidea bimacula Jenkins. Hawaii.

Family POMACENTRIDÆ.

PREMNAS Cuvier.

799. Premnas biaculeatus (Bloch). New Guinea (Macleay); East Indies.

AMPHIPRION Bloch & Schneider.

800. Amphiprion melanopus Bleeker. Samoa; Tonga; Ponape; Solomon Is.; Guam; Woodlark I.; New Guinea; East Indies; D'Entrecasteaux Is. (Macleay.)

Amphiprion melanopus Bleeker, Amboina, Nat. Tijds. Ind., III, 561, Amboina. Gunther, Cat., IV, 8.
Prochilus melanopus Bleeker, Atlas, Pomacentridæ, 26, tab. CCCCI, fig. 7, 1877, Singapore, Ceram, Ternate, Amboina, Solor, New Guinea.
Amphiprion ephippium Gunther, Fische der Südsee, 225, **Tonga, Samoa, Ponape, Solomon Is.** Seale, Bishop Museum 1901, 82, Guam, not of Bloch.
Amphiprion monofasciatus Thiollière, Fauna Woodlark, 198, 1857, **Woodlark I.**

Of this species four specimens were taken by us at Apia, and one at Pago Pago. The specimens agree well with Bleeker's plate and with each other, and the species is no doubt a valid one.

Life colors of a specimen from Apia, deep reddish brown, the caudal peduncle bright brownish, the anterior region deep orange brown or cinnamon; a pale violet stripe across head edged before and behind with indigo-blue; ventral and anal black; dorsal reddish brown; paler behind; pectoral deep cinnamon brown; caudal pale brownish yellow.

801. Amphiprion arion De Vis. South Seas.

Amphiprion arion De Vis, Proc. Linn. Soc. N. S. W. 1884, 450, **South Seas.**

802. Amphiprion polymnus (Bloch). Palau Is.; Ponape; East Indies; Japan.

According to Günther this species, with *melanopus, tricolor, chrysopterus*, and *xanthurus*, is based on variants of *Amphiprion ephippium.* This view is open to question.

803. **Amphiprion tricolor** Günther. Palau Is.; New Guinea; East Indies.

804. **Amphiprion xanthurus** Cuvier & Valenciennes. Samoa (Günther); Ponape.

805. **Amphiprion chrysopterus** Cuvier & Valenciennes. Kingsmill I. (Günther); Bourbon I.

806. **Amphiprion bicinctus** Rüppell. Solomon Is.; Guam; East Indies.

807. **Amphiprion percula** (Lacépède). Borabora; Vanicolo; New Guinea; New Ireland; New Britain; Solomon Is.

808. **Amphiprion papuensis** Macleay. New Guinea.
Amphiprion papuensis Macleay, Proc. Linn. Soc. N. S. W. 1883, 271.

809. **Amphiprion perideraion** Bleeker. Palau Is.; East Indies.

810. **Amphiprion bifasciatus** (Bloch). New Guinea; East Indies.

811. **Amphiprion rosenbergi** Bleeker. New Guinea.

POMACENTRUS Lacépède.

812. **Pomacentrus pavo** (Bloch). *Taupou.* Samoa; Tahiti; Ponape; Bonham I.; Woodlark I.; New Britain (as *Pomacentrus notatus* De Vis, Proc. Linn. Soc. N. S. W. 1884, 451); East Indies. (Pl. XL, fig. 1.)

This beautiful little fish is very abundant about the coral reefs of Samoa, and is the handsomest of all blue fishes called *taupou*, or damsel. We have about 100 specimens. In the smaller examples the back and sides are nearly uniform sky-blue. In the adult the blue becomes differentiated as streaks and lines on each scale, the orange ground color nearly hidden by the blue markings.

Pomacentrus notatus De Vis seems to agree fully with *Pomacentrus pavo*. It is doubtless the same species.

Life colors were noted as follows in various specimens of *P. pavo:*

(1) Specimen from Apia, called *taupou*. Brilliant sky-blue, grayer below and on caudal peduncle; a dark steely edge on each scale; head profusely spotted with blue, the spots small and darker-edged; a large black ocellus on opercular angle; dorsal blue, deep blue on distal half, the tips of first soft rays almost black, posterior rays mostly golden; caudal golden, pale blue mesially at base; anal pale blue, distally pale olive; pectoral and ventral slightly yellowish.

(2) From Apia. Deep violet-blue, clear, the dorsal, anal and caudal, with caudal peduncle, shading into bright golden; base of dorsal and anal deep blue; a small opercular spot, none on body or axil; pectoral pale yellowish; ventral blackish.

(3) From Pago Pago. Deepest violet-blue, intensely dark blue on back; head with many pale sky-blue dots and curved lines; two from eye to mouth; a blue line around chin; caudal peduncle and posterior part of soft dorsal and anal with whole caudal deep orange yellow; a deep black spot on opercular angle; axil with a blue dot rather faint; no spot in axil of dorsal and anal; spinous dorsal and front of soft dorsal deep blue, edged with sky-blue; ventral and pectoral pale bluish; anal and dorsal pointed; caudal pointed with unequal lobes; breast blue, with dark streaks.

(4) From Apia. Bright blue, with indigo markings on head; a black opercular spot with a white one before it; spinous dorsal deep blue; soft dorsal golden; caudal pure yellow; anal pale yellow; no fin spots; ventral blue; belly pale blue; pectoral colorless.

(5) From Pago Pago. Vivid blue head, shoulders and back, with numerous spots of light blue, also violet; small black opercular spot; axil unspotted; first dorsal blue, with blackish edge; second dorsal golden, black-edged; no black spot; caudal and caudal peduncle bright yellow; anal blue; ventral dusky, pectoral bluish.

813. **Pomacentrus cyanomus** Bleeker. New Guinea (Macleay).

814. **Pomacentrus prosopotænia** Bleeker. New Guinea (Macleay); East Indies.

815. **Pomacentrus tæniurus** Bleeker. Tahiti and Faté (Seale); East Indies.

816. **Pomacentrus bifasciatus** Bleeker. Boston I.; East Indies.

817. Pomacentrus trimaculatus Cuvier & Valenciennes. Palau Is.; Guam; Marcus I.; New Guinea (Macleay); East Indies.

This species is easily recognizable by the black spots on the side of the back. It was not taken by us. Bleeker identifies *P. perspicillatus* with *P. trimaculatus*, but the description of the former is too scanty to permit of certainty.

818. Pomacentrus notophthalmus Bleeker. Woodlark I.; Faté; New Hebrides (Seale); East Indies.

This species, not taken by us, is very well marked by its coloration, the anterior dorsal region being violet-brown, the rest of the body largely yellow.

819. Pomacentrus vaiuli Jordan & Seale, new species. *Vaiuli.* Samoa. (Pl. XL, fig. 2.)

Head 3.50 in length; depth 2; eye 2.85 in head; dorsal XIII, 14; anal II, 16; scales 3-30-9, twenty scales in lateral line proper, which ends under posterior third of soft dorsal fin; interorbital equal to eye; snout 3.40 in head.

Body compressed, elevated, the upper and lower outlines evenly rounded; depth of caudal peduncle 2 in head, its length 2.75; mouth small; maxillary reaching to below anterior margin of eye, a single series of rather flat cutting teeth in each jaw; no teeth on vomer or palatines; preorbital rather wide, 2 in maxillary, its lower posterior margin strongly toothed; suborbital very narrow, about one-half as wide as preobital, its lower margin toothed; opercle entire; preopercle denticulate; gill-rakers rather blunt, the longest less than width of pupil; base of dorsal 1.75 in length of fish without caudal, its longest ray 1.20 in head; posterior extremities of dorsal and anal pointed; base of anal equal to head; pectoral equal to head; first rays of ventral somewhat prolonged and filiform, reaching to base of anal; caudal forked, its lobes slightly longer than head.

Color in spirits, purplish, lighter with yellowish wash on upper third of body, the colors thus being reversed from the usual coloring in fishes; scales with blue dots in the center which form numerous blue longitudinal lines on body, about 17 on each side, some more or less irregular, the upper one of the lines extending from tip of snout over interorbital space along base of dorsal; the second has its origin on nuchal region; the third has its origin at posterior of orbit; two narrow blue lines from orbit to mouth; a distinct black opercular spot; a black blue-edged ocellus on the base of the 7 posterior soft dorsal rays; dorsal yellowish with dark margin; caudal bright yellow; pectoral bright yellow; ventral and anal dark blue; the anus has 3 bands of blue dots.

Life colors were noted in various specimens as follows:

(1) Specimen from Apia called *vaiuli* (blue water). Brilliant deep blue, darkest below: the back abruptly orange-yellow with two blue stripes on each side, breaking up behind into rows of dots; no median stripe; dorsal orange with blue edge and blue dots; soft dorsal with a large, black, blue-edged ocellus; caudal and pectoral golden; ventral and anal blue-black.

(2) From Apia. Deep purplish; dull golden about gill-openings and on tail; sides of head and region of gill-opening with numerous sky-blue spots; a small round black spot on angle of opercle above black speck in axil; dorsal brownish, dull golden behind with a black, bluish-edged ocellus on base of soft dorsal; obscure blackish band along middle of spinous dorsal; anal brownish, with four or five oblique irregular blackish bands; pectoral and caudal golden; ventral blue-black.

(3) From Pago Pago. Iridescent purple-blue on sides in post-pectoral region, fading behind into brown-blue; above rich umber with blue in longitudinal series of dots; dorsal light umber with a very narrow marginal bright blue line; anal purplish brown; pectoral thin clear yellow, purple-violet below; dorsal with black ocellus with narrow blue margin on posterior end.

(4) From Apia. Back golden brown, grayish on tail; sides and belly deep blue; a row of dark blue spots along each row of scales; two dark blue stripes from snout to dorsal; dorsal golden brown, blue-shaded; a large, black ocellus, blue-edged, on the base of last soft rays; caudal pure golden; anal blue-black, with two oblique shades across it; pectoral golden; ventral blue-black.

The young of this species is remarkable for the reversal of the coloration, the back being golden, the lower parts violet black. With age, the dark coloration extends upward on the back. The black opercular spot and the black ocellus at the end of the soft dorsal remain the same at all ages. The violet spots on the side grow fainter with age but do not disappear.

Fifteen specimens from Apia and one from Pago Pago. The type, no. 51740, U. S. National Museum, is 2.75 inches long.

Digitized

820. **Pomacentrus tripunctatus** Cuvier & Valenciennes. Vanicolo; Fiji; East Indies.

Pomacentrus tripunctatus Cuvier & Valenciennes, Hist. Nat. Poiss., v, 421, 1830, **Vanicolo.**

? *Pomacentrus trilineatus* Ehrenberg in Cuvier & Valenciennes, op. cit., v, 428, 1830, **Red Sea.** Sauvage, Poiss. Madagascar, 423.

Pomacentrus tæniometopon Kner, Sitz. Ak. Wis. Wien 1858, 56, **Kandavu.**

This species was not taken by us. The black ocellus on the back of the tail seems to be a distinctive character. It is doubtful whether *Pomacentrus dorsalis* of Japan is the same species.

821. **Pomacentrus amboinensis** Bleeker. New Guinea (Macleay).

822. **Pomacentrus bankanensis** Bleeker. Guam; East Indies.

823. **Pomacentrus semifasciatus** Günther. Boston I., Marshall Group.

Pomacentrus semifasciatus Günther, Fische der Südsee, 226, with plate, 1873, **Boston I.**

This species was not seen by us.

824. **Pomacentrus jenkinsi** Jordan & Evermann. Hawaii.

825. **Pomacentrus analis** Macleay. New Guinea.

Pomacentrus analis Macleay, Proc. Linn. Soc. N. S. W. 1883, 364.

826. **Pomacentrus melanopterus** Bleeker. *I'u sina; Tu'u'u.* Samoa; East Indies.

Pomacentrus megalops Sauvage, Poiss. Madagascar, 426; after Liénard.

Ten specimens from Apia. This species is easily separated from *P. nigricans* and other black species by the large black spot covering the whole base of the pectoral. From most of the black species it may be known by the presence of 13 dorsal spines, there being but 12 in *P. nigricans* and *P. lividus.*

Life colors of a specimen from Apia, called *tu'u'u*, all black, a large jet black spot or cross bar on base of pectoral; belly with coppery shade; gray spots on scales.

827. **Pomacentrus littoralis** Kuhl & Van Hasselt. Tahiti; Caroline Is.; Waigiu; Guam; Shortland I.; Raiatea and Makatea (Seale); East Indies.

This species is distinguished by the presence of 13 dorsal spines, a plain dusky coloration with a black spot on the tip of the opercle only, and a strongly serrate suborbital. In *P. inornatus*, which is similarly colored, this bone is nearly entire. In *P. nigricans*, *P. lividus*, and its allies or variations there are 12 dorsal spines.

This species was not taken by us. The species called *P. emarginatus* and *P. chrysurus* are almost certainly identical. They would be certainly placed in *P. littoralis* were it not stated that the caudal is yellow, and there is no mention of an opercular spot. According to Sauvage, the *littoralis* of Bleeker is a different species, properly called *Pomacentrus pristiger* Cuvier & Valenciennes.

828. **Pomacentrus inornatus** De Vis. Samoa.

Pomacentrus inornatus (misprinted *niomatus*) De Vis, Proc. Linn. Soc. N. S. W. 1884, 451, **South Seas.**

Three specimens from Apia. This fish is plain blackish, without spot. The nose is distinctly blacker than the rest of the body. There are 13 dorsal spines, largely enveloped in the scaly sheath, and the suborbital is almost entire, without the strong retrorse serrations seen in most of the other black species. The species is certainly identical with *P. inornatus* of De Vis. *Pomacentrus emarginatus* seems to differ in the strongly serrated preorbital.

829. **Pomacentrus nigricans** Lacépède. *Tu'u'u.* Samoa; Fiji; Tonga; Palau; Ponape; Tahiti; Raiatea; Marquesas I. and Faté (Seale); East Indies.

(*Pomacentrus scolopseus* Quoy & Gaimard; *Pomacentrus tæniops* Lesson.)

This species is very abundant in all the pools on all the coral reefs of Upolu and Tutuila. It may be known from its intimate associate, *P. lividus*, with which Bleeker has confounded it, by the narrow preorbital, more extensively scaled forward. In both species there are 12 dorsal spines, and the preorbital is strongly serrated. Usually the color of the body is plain dusky olive, without blue spots. The dusky spot or shade on soft dorsal and on axil of pectoral is variously developed, sometimes very distinct, sometimes obscure. The blue stripe on the suborbital is usually but not always distinct.

Either this species or *P. albofasciatus* must be the original *P. nigricans* of Lacépède. In view of the fact that *albofasciatus* is perhaps a color variation, or else the female of *scolopseus*, we may adopt the name *nigricans* for the latter or for both.

Life colors of a specimen from Apia, greenish black; a sharp pale streak below eye; base of pectoral black; spinous dorsal, anal and base of soft dorsal and caudal blackish; pectoral bright yellow; rest of soft dorsal and caudal bright yellow, brightest behind.

A specimen called *tu'u'u*, from Apia, was sooty; middle of body paler olivaceous, darker above, livid bluish below; two blackish cross shades under front of dorsal; posterior parts and head black; opercle, iris, space below eye violet; axil black; fins all black, paler behind; axils of dorsal and anal very black.

A young individual from the same locality was olive; brownish anteriorly, yellowish behind middle; dorsal dull orange, with a large jet-black spot in the axil; caudal golden; anal black, with orange shade; pectoral golden with a black spot in the axil; ventral black.

The original *Pomacentrus nigricans* is described from an unknown locality in the Pacific. It is plain blue-black, the depth half the length, the preorbital serrate; dorsal XII, 17, anal II, 15. It can be no other species, as the other black ones have 13 dorsal spines. *Pomacentrus nigricans* of Quoy & Gaimard and of later writers is *Pomacentrus jenkinsi*, a species with 13 dorsal spines.

830. Pomacentrus albofasciatus Schlegel. *Ulavâpua.* Samoa; Palau I.; East Indies.

This species or form is abundant about Samoa, swarming in the crevices of the reefs. We have over a hundred specimens from Apia and Pago Pago. It is dull-colored, usually blue-black, with a broad whitish cross-band on the posterior part of the body. This band is never wholly absent. There is also a black pectoral spot and a black blotch, not ocellated on the last rays of the dorsal. This species is regarded by Günther as a variety of *P. scolopseus.* We find no difference except in the presence of the broad pale cross-band in *albofasciatus.* This is wanting in *S. nigricans.* It is usually but not always present in the form or species called *eclipticus*, which has in addition a short very white bar before the black dorsal spot. The three forms agree in all other regards, and are probably, as Dr. Günther has indicated, variations of *Pomacentrus scolopseus*, or *Pomacentrus nigricans*, to adopt the earliest name given to any of these dusky species with 12 dorsal spines. All the dusky species of *Pomacentrus* have 13 dorsal spines, excepting *Pomacentrus nigricans* and its allies or variations. Eight of our specimens of *Pomacentrus albofasciatus* are females. Two are apparently male, but may possibly be spent females. Both males and females are found among the specimens of *nigricans* and *eclipticus.*

Life colors of a specimen from Pago Pago, brown with vertical pale blue streaks on many of the scales; a broad, yellowish-white cross-band under last dorsal spines; a violet-pink streak below eye; violet scale above axil; axil black, as also base of pectoral; dorsal colored like body; first three spines black, rest pale; soft dorsal with large black blotch in axil; caudal dull olive-gray; anal similar, with violet dots on scales at base, and with violet edge; ventral dusky with thin violet edge; pectoral dull.

A specimen from Apia, called *ulavâpua*, was dirty olive; a yellowish cross-band under soft dorsal.

831. Pomacentrus eclipticus Jordan & Seale, new species. Samoa.

Head 3.20 in length; depth 2.20; eye 3 in head, equal to interorbital space; dorsal XII, 15; anal II, 12; scales 3-29-9, 19 in lateral line.

Body oblong, compressed, elevated, scales covering head and body; caudal peduncle 2 in head, its depth equal to its length; mouth small, its angle under anterior margin of eye; a single row of rather flat cutting teeth in each jaw, no teeth on vomer or palatines; opercle with a single flat spine on margin; preopercle strongly denticulate also, its width at angle of mouth equal to pupil, directly below median line of eye, preorbital width two-thirds of pupil; gillrakers not very sharp, the longest two-thirds width of pupil, 9 on lower limb; spines of dorsal graduated posteriorly, the last being the longest, 2 in head; first dorsal spine less than eye; middle ray of soft dorsal the longest, 1.45 in head; base of anal 1.25 in head, its longest spine about equal to base; pectoral 1.10 in head, its tip on line with 11th scale of lateral line; first rays of ventral slightly elongate, extending to anal opening, the length slightly greater than head; caudal forked, the lobes rounded, the upper one slightly the longer, about equal to head.

Color in spirits ranges from light yellowish brown to dark brown, almost black; the type specimen is light yellowish brown, with slight shading of dusky on head and upper surface of body; all specimens show a distinctive black spot in axil of soft dorsal with a white spot of equal size and shape just anterior to the dark spot; in size this dark spot is equal to the orbit in height and two-thirds of orbit in width; a very distinct black spot on the upper base of pectorals which extends into the axil of the fins; a more or less distinct blue line on preorbitals, and there may be 3 or 4 indistinct pearl-colored spots on the opercles or cheeks; dorsal fin with a black blotch near margin of 3-4 spines, with a yellowish white line below; in general, the fins follow the shading of color shown on the body, the dorsal with a narrow margin of dusky, the anal with a dusky blotch; ventral with a dusky wash; iris blue.

Life colors of a specimen from Apia, dull brownish, paler behind middle of body; fins plain; a large black spot on last rays of soft dorsal; a large golden one before it; a black spot in anal axil, one in pectoral axil, and one on opercle.

A specimen from Pago Pago was black, blacker on base of last dorsal and anal rays; a short, vertical whitish bar just before the spot on dorsal; a black blotch on base of pectoral, covering axil; fins all black, the caudal and soft dorsal a little paler at tip; iris brownish; preopercle serrate, a faint rather broad blue streak below eye to tip of snout.

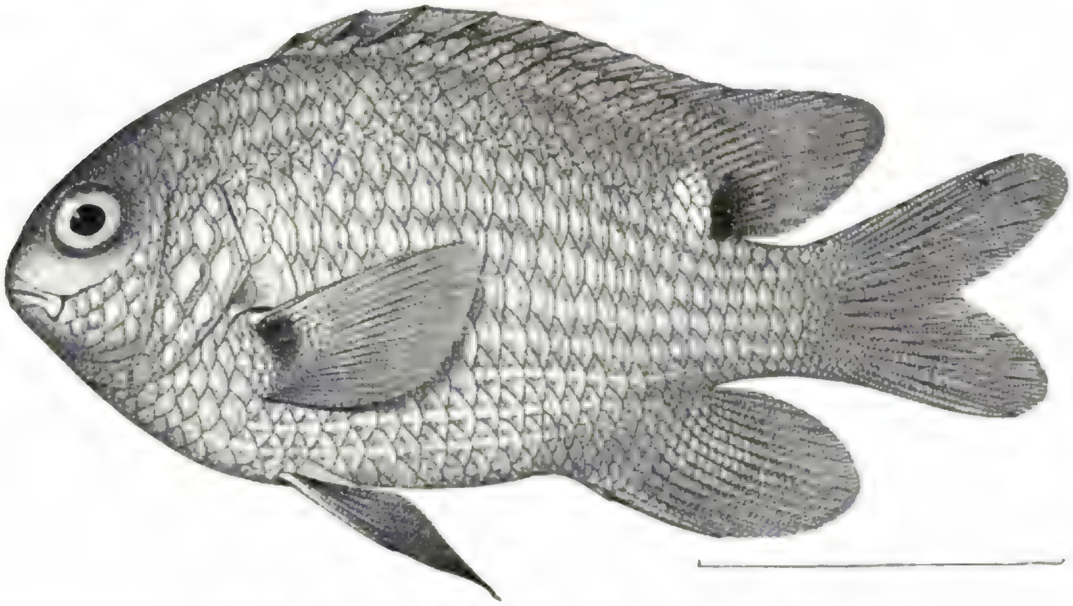

FIG. 50.—*Pomacentrus eclipticus* Jordan & Seale, new species. Type.

Of this abundant species or form, we have about 30 examples from Apia and 10 from Pago Pago. The species may be known by its plain coloration, the pectoral spot being distinct and the dorsal spot still more so, preceded by a short vertical bar, which is typically pure white. Among our specimens are both males and females, a fact which shows that this is not the male of *Pomacentrus albofasciatus*. For the present we may regard it as a distinct species.

The type is no. 51735, U. S. National Museum, from Apia, length 3 inches.

832. Pomacentrus lividus (Forster). *Tu'u'u sue uli; I'u sina.* Samoa; Vavau; Ponape; Boston I.; Borabora; Huahine; Santa Cristina; Fiji; Marcus I.; Tahiti; Guam; Faté; Nukahiva and Raiatea (Seale).

Chætodon lividus (Forster), Bloch & Schneider, Syst. Ichth., 235, 1801, **Bolabola.**
Eupomacentrus lividus, Bleeker, Pomac., 73, 1877, East Indies generally.
Pomacentrus lividus, Sauvage, Poiss. Madagascar, 426.
Pomacentrus punctatus, Quoy & Gaimard, Voy. Uranie, 395, taf. 64, fig. 1, 1824, **Ile de France.** Günther, Cat., IV, 29. Kner, Novara Fische, 243, Tahiti, Nicobar Is. Seale, Bishop Museum, 1901, 80, Guam. Bryan & Herre, Bishop Museum, 1903, Marcus I.
Pomacentrus prosopotænioides Bleeker, Amboina and Ceram, 286.
Pomacentrus cyanospilos Bleeker, Ceram, II, 709, **Ceram.** Gunther, Cat., IV, 30, East Indies. Günther, Fische der Südsee, 229, taf., Boston I., Upolu, Vavau, Ponape, Huahine, Borabora, Santa Cristina.
Pomacentrus vitianus Sauvage, Bull. Phil. Soc., III, 1879, 206, **Viti Levu (Fiji).**

This large species is very abundant in the rock pools of the coral reefs of Samoa. It is found in company with *Pomacentrus nigricans*, which it much resembles. It is, however, easily distinguished by the broad naked preorbital, a character well shown in Günther's plate. The blue or whitish spots are generally conspicuous, especially on the sides of the head.

We can not see that *Pomacentrus vitianus* Sauvage differs in any respect from *Pomacentrus lividus*.

Life colors of various specimens were noted as follows:

(1) From Pago Pago. Violet-black, with three obscure black cross-bands; eye bluish; a violet stripe below eye to snout; a violet shade on opercle; a faint dark blotch at base of pectoral; no spot, either black or white, in axil of dorsal; fins all black.

(2) Same locality. Black body and fins; axil with a black spot extending on base of pectoral; anal edged with violet-blue; fins all black.

(3) From same locality; specimen called *i'u sina* (white tail). All black, unspotted; axil and broad bar across base of pectoral black; edge of dorsal, anal, and caudal dull whitish.

(4) From Apia. Grayish black mottled with sooty gray; a round black opercular spot; no other markings; ventral black.

(5) From Apia. Dull olive brown, each scale posteriorly with a black spot; dorsal dusky, the soft dorsal dull yellow at base, with a curved black bar behind it; anal similarly marked; caudal dull yellow at base; pectoral dull orange; ventral brownish.

(6) From Apia; fins low. All grayish black; base of dorsal, anal, and caudal golden washed; axil dark.

833. Pomacentrus devisi Jordan & Seale, new name. South Seas.

Pomacentrus trifasciatus De Vis, Proc. Linn. Soc. N. S. W. 1884, 452, **South Seas**; name preoccupied.

834. Pomacentrus onyx De Vis. South Seas.

Pomacentrus onyx De Vis, Proc. Linn. Soc. N. S. W. 1884, 451, **South Seas**.

ABUDEFDUF[a] Forskål.

(*Glyphisodon* Lacépède; *Stegastes* Jenyns; *Chrysiptera* Swainson; *Euschistodus* Gill; *Paraglyphidodon*, *Glyphidodontops*, *Hemiglyphidodon*, and *Amblyglyphidodon* Bleeker.)

835. Abudefduf sordidus (Forskål). *Ulavāpua.* Samoa; Hawaii; Tahiti; Raiatea; Bonham I.; Faté and Makatea (Seale); East Indies.

This species, recognizable by its large size, by faint dark cross-bands, and the black spot below the axil of the dorsal, is common throughout the tropical Pacific. It is abundant both at Hawaii and Samoa, but is found among lava rocks only, not about the coral reefs. A specimen from Apia in life had six dark cross-bands and the usual spot at base of last dorsal ray.

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[a] We have referred the question of the propriety of the use of *Abudefduf* instead of *Glyphisodon*, and of the rejection of *Abuhamrur*, *Farer*, and other quasi subgeneric names of Forskål, to our friend Dr. Leonard Stejneger. From a letter dated November 23, 1904, we quote his view of the matter, with which we fully concur:

"Forskål, we are informed, based his nomenclature and systematic arrangement principally on Linnæus, 10th ed., probably the only systematic work he had with him. It is therefore of importance to examine into the "subdivisiones" of genera which Linnæus employed. He has four kinds, for instance:

1. *Perca*, p. 289.
X. Pinnis dorsalibus 2 distinctis.
XX. Dorso monopterygio, etc., etc.
2. *Cimex*, p. 441.
a. Apteri.
b. Scutellati.
c. Coleoptrati, etc.

3. *Salmo*, p. 308.
X. Truttæ.
XX. Osmeri.
XXX. Coregoni.
4. *Gryllus*, p. 425
X. Mantis.
XX. Acridia.
XXX. Bulla, etc.

Only the fourth kind of subdivision corresponds exactly to our subgenus, but the names of subdivision 3 are by common consent treated as subgenera and used as such in the singular (thus by yourself and Dr. Evermann in Fishes of North and Mid. America). Of course the names of the second division have never been used in this sense, and in No 1 there are no names.

The question as to Forskål's names then resolves itself to which of these categories they are to be referred. If they are used as subgenera, or in a subgeneric sense like category 3, we must accept them.

It seems then to me that *Abudefduf* comes within category 4. Both *Chætodon* and *Acanthurus* are in the singular, and *Abudefduf* is in no manner distinguishable from them.

On the other hand, *Perca dentibus Louti*, *Duba*, *Scarus dentibus Sidjan*, *Abu djubbe*, *Harid*, fall under category 1.

The subdivisions of *Sciæna* (p. 44) seem to me to be very much of a similar character, or, rather they correspond almost exactly to the modern way of subdividing "*commode*" such large genera according to groups of species which we

836. Abudefduf septemfasciatus (Cuvier & Valenciennes). *Mutu; Alala saga.* Samoa; Guam; Faté; Shortland I.; Rarotonga; Raiatea and Makatea (Seale); East Indies.

Of this well-marked species we have four large examples from Apia. Life colors of one of these, called *mutu*, dull olive, with black bars, six wider than interspaces; silvery streaks faint along rows of scales; pale whitish streak along spinous dorsal; everything else pale.

837. Abudefduf saxatilis (Linnæus). Samoa; Waigiu; Tubuai (Seale); Marcus I.; East Indies; Japan.

This species, common from Japan to the Red Sea, is occasionally taken in the South Seas. We have one large example, corresponding to *Abudefduf waigiensis* from Apia. In Hawaii it is replaced by *Abudefduf abdominalis*, and in America by the equally closely related *Abudefduf marginatus*.

838. Abudefduf abdominalis (Cuvier & Valenciennes). Hawaii; Laysan.

839. Abudefduf cœlestinus (Cuvier & Valenciennes). *Fili mama.* Samoa; Ulietea; New Guinea; Waigiu; Tahiti; Raiatea; Faté and Shortland Is. (Seale). (Pl. XLI, fig. 1.)

This species is very common about Samoa, nearly a hundred specimens being taken at Apia and Pago Pago. It is perfectly well distinguished from *Abudefduf saxatilis*, and rarely inhabits the same waters. Its life color is pale sky-blue, not olive-green, and the black stripe on each lobe of the caudal is constant.

A specimen from Apia in life was vivid sky-blue with paler streaks along scales; cross-bands jet black, a black stripe on each caudal lobe.

840. Abudefduf curacao (Bloch). New Guinea (Macleay); Shortland I. (Seale); East Indies; Japan.

841. Abudefduf dicki (Liénard). *Tu'u'u.* Samoa; Ponape; Guam; East Indies. (Pl. XLI, fig. 2.)

Glyphisodon unifasciatus Kner & Steindachner, Sitz. Ak. Wiss. Wien 1867, 375, **Samoa.**

Of this handsome and well-marked species half a dozen specimens were taken at Apia. Life colors of one of these, called *tu'u'u*, golden brown, dark, each scale with a vertical bar of dark blue; a large jet-black crescent from front of soft dorsal across body and covering most of anal; behind this abruptly pale orange-red, the color covering caudal peduncle, caudal and last rays of dorsal and anal; older examples have color deeper, clear orange-red behind black crescent; pectoral bright golden yellow, dusky behind; ventral blackish; head plain.

842. Abudefduf lacrymatus (Quoy & Gaimard). *I'u samasama* (yellow tail). Samoa; Guam; Yap; Howland I.; East Indies.

Of this well-marked species, black, with bluish white well differentiated spots, we have three specimens from Apia.

Life colors of a specimen called *i'u samasama*, black, with scattered round spots of deep violet-blue, on head, nose, back and sides, also on dorsal; caudal peduncle, caudal and posterior part of soft dorsal abruptly pale grayish yellow, the color of the ginger flower; fins otherwise black, the anal washed with orange; dorsal and spinous anal with violet spots; ventral black, edged with blue; axil a little dusky.

Another specimen was black (brownish) with bright violet shade on opercle and preorbital and numerous violet-blue spots on spinous dorsal, which has a narrow blue edging; axil black, dorsal black, its last rays abruptly bright orange; caudal dusky orange-brown; anal black with pale blue anterior edge; pectoral dusky; ventral blackish.

843. Abudefduf behni (Bleeker). Samoa; Rarotonga (Seale).

Of this species, pale brownish black, with a black axillary spot, we have one fine specimen from Apia.

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do not wish to split up nomenclatorially. It is as if I should say the enormous genus of *Rana* can be subdivided for the sake of convenience into (1) the *temporaria* group; (2) the *esculenta* group, etc. That Forskål (or his editor) uses capitals and an upper case capital initial means nothing, for he also has "(C) *Immaculatæ*" exactly like *Abu hamrur*.

The case of the *Sciænas*, i. e., *Abu hamrur*, etc., is not exactly like that of *Abudefduf*, and I believe there is just difference enough to draw the line just between them. I do not believe they fulfill the conditions for being subgenera, while *Abudefduf* does."

844. **Abudefduf melas** (Bleeker). Laysan (Steindachner); East Indies.

845. **Abudefduf nigrifrons** (Macleay). New Guinea (Proc. Linn. Soc. N. S. W. 1884, 271).

846. **Abudefduf bimaculatus** (Macleay). New Guinea.

847. **Abudefduf leucogaster** (Bleeker). Shortland I. (Seale); East Indies.

848. **Abudefduf pallidus** (De Vis). New Guinea.

Abudefduf pallidus De Vis, Proc. Linn. Soc. N. S. W. 1884, 452.

849. **Abudefduf imparipennis** (Vaillant & Sauvage). Hawaii.

850. **Abudefduf filamentosus** (Macleay). New Guinea.

Abudefduf filamentosus Macleay, Proc. Linn. Soc. N. S. W. 1883, 365.

851. **Abudefduf plagiometopon** (Bleeker). New Guinea (Macleay).

852. **Abudefduf emamo** (Lesson). Borabora.

Glyphisodon emamo Lesson, Voy. Coquille, 190, 1830, **Borabora**.

853. **Abudefduf sindonis** (Jordan & Evermann). Hawaii.

854. **Abudefduf bankieri** (Richardson). New Guinea (Macleay); East Indies.

855. **Abudefduf anabatoides** (Bleeker). New Guinea (Macleay); East Indies.

856. **Abudefduf glaucus** (Cuvier & Valenciennes). Samoa; Guam; East Indies.

Glyphisodon glaucus Cuvier & Valenciennes, Hist. Nat. Poiss., v. 475, 1830, **Guam**.
Glyphisodon modestus Schlegel, Amphipr., 23, tab. 6, fig. 2, **East Indies**. Bleeker, Pomacentridæ, 131. Bleeker, Atlas Ichth., tab. IV, fig. 9, Sumatra, Java, Borneo, Amboina. Günther, Cat., IV, 55, Java.
Glyphisodon phaiosoma Bleeker, Verh. Bat. Gen., XXII, Ichth. Bali, 9, **Bali**.

This species is common about Samoa, where about 100 specimens were taken. It resembles *Abudefduf zonatus*, but is of a washed-out blue color in life without white bar or black ocellus.

Life colors of a specimen from Apia, pale sooty olive, yellowish on belly; fins all grayish; preopercle and preorbital with pale edge; a dull orange tint on soft dorsal and caudal; pectoral deep yellow, soiled with dusky; anal dark-edged anteriorly.

Another specimen from Apia was violet-blackish with green luster; fins all pale bluish with yellowish tinge; ventral bright yellow; no fin spots; three whitish spots violet-tinged on sides on level of pectoral, O-shaped; more of these on other side and irregular.

857. **Abudefduf zonatus** (Cuvier & Valenciennes). *Tu'u'u.* Samoa; Fiji; New Guinea; East Indies.

Glyphisodon zonatus Cuvier & Valenciennes, Hist. Nat. Poiss., v, 483, 1830, **New Guinea**. Bleeker, Pomacentridæ, 138, and Atlas, 407, fig. 3, Cocos, Java, Borneo, Celebes, Ceram, Amboina, New Guinea.
Glyphisodon brownriggii Günther, Fische der Südsee, 232, taf. 127, figs. C, E, A; not of Bennett.
Glyphisodon rossii Bleeker, Kokos, 48, **Cocos I.**
Glyphisodon albocinctus Kner, Sitz. Ak. Wiss. Wien, 351, **Fiji**.
Glyphisodon leucozona Kner, Sitz. Ak. Wiss. Wien, 350, **Savay**; not of Bleeker.
Glyphisodon cingulatus Kner, Sitz. Ak. Wiss. Wien, LVI, 1867, 725, **Fiji**.

This little species is very common about Samoa, 150 specimens, of all sizes, being taken. None shows blue stripes or lines, and nearly all have a single white bar on each side. This is lost in the very oldest. In the largest of all is a distinct whitish blotch on the soft dorsal near its last rays.

Life colors of various specimens were noted as follows:

(1) Specimen called *tu'u'u*, from Apia. All blackish, with pale centers to scales; head reticulated gray and blackish; a black speck at end of opercle; caudal with yellowish shade at base; fins otherwise black; caudal and soft dorsal paler behind; pectoral dusky and black.

(2) From Apia. Dusky olive; a white cross-bar under middle of body; a black ocellus edged with white on last dorsal spines; dorsal pinkish dusky; other fins all dusky.

(3) From Pago Pago. Blue-blackish; a broad whitish gray cross-band; an obscure black spot under last dorsal spines; a jet-black spot in axil of last dorsal ray; dorsal dull orange, blackish at base; caudal dull orange; pectoral yellow, axil black; ventral and anal blackish.

(4) From Apia. Deep steel-blue, each scale with a paler center along side; a distinct white band under middle of soft dorsal; dorsal black at base, the upper two-fifths orange, not very bright; belly dusky; no opercular spot or ocellus; caudal dull orange, the edge dark; anal all blue-black, as is also ventral; pectoral golden, a black bar across its base, the axil dark.

(5) From Apia. Blackish; large white stripes along rows of scales; a whitish bar below middle of spinous dorsal; dorsal and anal dusky; soft dorsal half dusky, the tip dull orange; anal almost all dusky; caudal dull orange; pectoral bright golden, no ocelli; ventral black.

(6) From Apia. Blue-black; each scale on front part of sides with a pale gray spot; a vertical whitish bar below middle of spinous dorsal; dorsal dusky bluish below, the upper half dull orange with a pale lateral streak; anal blue-black; caudal sooty; pectoral yellow; ventral blackish.

858. Abudefduf hemimelas (Kner). Fiji.

Glyphisodon hemimelas Kner, Sitz. Ak. Wiss. Wien 1868, pl. VIII, fig. 25, 351, **Fiji.**
Glyphidodon brownriggii var. *hemimelas*, Günther, Fische der Südsee, 233.

This species is not known to us. From the figures of Kner and Günther, it would seem to be a species distinct from *A. zonatus*. Dr. Günther regards it as a "variety" of "*Glyphidodon brownriggii;*" that is, of *Abudefduf zonatus*.

859. Abudefduf amabilis (De Vis). Samoa; Tahiti; Oualan; Faituna; Fiji; Ponape. (Pl. XLII, fig. 1.)

Glyphisodon amabilis De Vis, Proc. Linn. Soc. N. S. W., 1884, 452, **South Seas.**
Glyphidodon brownriggii var. *xanthozona* Günther, Fische der Südsee, 234, taf. 127, fig. D, Oualan, Futuna, Samoa, Tahiti, Ponape; not *Glyphisodon xanthozona* Bleeker.

This species is very abundant about Samoa. Dr. Günther regards it as a "variety" of *Abudefduf zonatus* ("*brownriggii*") from which it differs wholly in color, though in little else. It is near *xanthozona* of Bleeker, but that species has yellow fins and a black ocellus on the dorsal, which is largely yellow.

Life colors of a specimen from Apia, blue-black; two yellowish white cross-bands; opercles orange; an orange streak across axil; base of pectoral dusky; dorsal dusky with a light brown tip; caudal dusky at base, then creamy with a dusky median blotch; pectoral pale yellowish.

860. Abudefduf antjerius (Kuhl & Van Hasselt). *Tu'u'u.* Samoa; Guam; New Ireland; Strong I.; New Guinea; East Indies. (Pl. XLII, fig. 2.)

Glyphisodon antjerius Kuhl & Van Hasselt, **Anjer (Java).** Cuvier & Valenciennes, Hist. Nat. Poiss., v, 481, 1830, Java. Günther, Cat., IV, 50 (in part). Günther, Fische der Südsee, 233. Seale, Bishop Museum, 1901, 83, Guam.
Glyphisodon biocellatus Cuvier & Valenciennes, Hist. Nat. Poiss., v, 482, 1830, Guam, Strong I., Java, New Guinea. Peters, Berl. Mon., 1876, 843, New Ireland.
Glyphisodon punctulatus Cuvier & Valenciennes, Hist. Nat. Poiss., v, 484, 1830, **Guam.**

This species is known to us from about 40 small specimens. It is near *Abudefduf zonatus*, but it never has a white lateral cross-band, and it always has a vivid blue stripe from snout to dorsal. Other blue dots and lines are usually present as well as a black ocellus near middle of dorsal fin. As our specimens differ widely from *Abudefduf leucopomus*, and from *zonatus* of the same size, we must regard *antjerius* as a species distinct from *zonatus*, *brownriggii*, and *leucopomus*.

Life colors of a specimen from Apia, called *tu'u'u*, blue-black above, a bright sky-blue stripe from eye to front of dorsal; a blue-black ocellus surrounded by sky-blue on last rays of spinous dorsal; a much smaller one on last ray at base; a blue dot in axil; body becoming more orange-yellow backward and downward; pectoral, soft dorsal and caudal brilliant yellow; anal orange-red, edged with dark; pectoral orange, with anal dark-edged.

Another specimen from Apia was steel-blue, not brilliant, each scale with a vertical pale dash; a pale shade under front of spinous dorsal; a large black spot under spinous dorsal, a smaller one in axil of soft dorsal; dorsal orange, edged with dark; caudal yellowish orange with a black edging; caudal peduncle and anal orange, edged with black; ventral black; pectoral golden.

861. Abudefduf leucopomus (Cuvier & Valenciennes). *Tu'u'u.* Samoa; Oualan; Guam; Nukahiva; Rarotonga (Seale). (Pl. XLIII, fig. 1.)

Glyphisodon leucopomus Cuvier and Valenciennes, Hist. Nat. Poiss., v, 480, **Oualan (Caroline Is.).**
Glyphidodon brownriggii, "Bastarde zwischen *G. brownriggii* und *G. uniocellatus*," Günther, Fische der Südsee, 240, 235, taf. 128, fig. B, **Apia, Oualan.**
? *Glyphisodon antjerius* Bleeker; not of Cuvier & Valenciennes.

This species, one of the prettiest of the taupos, or damsel fishes, is common about the reefs of Samoa, where about 50 specimens were taken. All these, young or old, have a broad blue stripe along side of back. Some are otherwise nearly plain golden, others show traces of dark cross-bands. The clear-colored ones are in general the largest and brightest examples.

A. brownriggii, of Ceylon and the East Indies, has a similar blue dorsal stripe, but according to the figures of Bennett, Bleeker and Day it lacks the large black spot at upper base of caudal. All our specimens in spirits have the opercle white, with a black spot at tip. The species may, however, prove inseparable from *A. brownriggii*.

Life colors were noted in various specimens as follows:

(1) From Apia. Bluish-black with blue and golden dots; a vivid blue stripe on each side of back; a black ocellus below soft dorsal; a larger one at base of caudal above; opercle golden with a black spot; axil not black; caudal peduncle before spot pale; dorsal orange and dusky bluish in alternate stripes; caudal orange-yellow; anal yellowish with oblique bluish stripes, very faint, the outer rays dusky; belly yellow, the breast and throat dark blue; ventral dusky orange; pectoral golden.

(2) From Apia. Blue-olive, with many blue dots; belly and tail golden; a broad vivid blue stripe along back; two black spots above it, the second in axil of last ray largest; a black band nearly across base of caudal; opercle golden with a black spot; a golden bar behind pectoral; fins all golden, the soft dorsal and anal orange at tip; first dorsal soiled with bluish; anal with a blue anterior edge.

(3) From Apia. Olive, a broad stripe of intense blue from snout above to base of caudal above, the two meeting around snout and around dorsal; a broad black median band on top of head to nape; two deep blue-black spots under soft dorsal, in front and in axil, the second the larger; a small spot at upper base of dorsal; belly gradually yellow; dorsal, anal, caudal, and ventral deep orange; pectoral a little paler; a blue streak along lower side of eye.

(4) From Pago Pago. Golden; blue back; two ocelli.

862. Abudefduf uniocellatus (Quoy & Gaimard). *Taupou.* Samoa; Fiji; Tonga; Marquesas Is.; Futuna; Vanicolo; New Hanover; East Indies. (Pl. XLIII, fig. 2.)

(*Glyphisodon assimilis* Günther.)

This beautiful species is very common about Samoa, where about 100 specimens were taken on the reefs. There is some difference in the color of the sexes, the females having the dorsal more or less yellow, the fin in the males being blue.

Life colors of a specimen from Apia, called *taupo*, most vivid blue with violet cross-streaks on back; scales on side with yellow dots; belly and lower part of side abruptly yellow; dorsal deep blue, the edge almost black, with a pale violet-blue median band; soft dorsal with an indigo-black blotch at base of last rays, anterior edge indigo-black, the median part blue-violet; caudal deep orange, bluish at base and above, the upper edge indigo-black; anal deep orange, its axil blue; pectoral and ventral blue, the ventral with some orange shade.

A specimen from Pago Pago was of deepest clear blue, sides with many small round golden spots; sides of head with violet specks; a black-violet streak from snout to eye, and upward and backward; three dark spots forming this streak; belly clear orange-yellow; dorsal deep blue; a large black blotch at base of last rays: soft dorsal pale orange, deep blue at base, the margin deep blue black; caudal orange-red, blue at base, the upper margin deep blue black; ventral orange-red, blue-edged; pectoral colorless.

863. Abudefduf taupou Jordan & Seale, new species. *Vaiuli sama; Taupou.* (Pl. XLIII, fig. 3.)

Head 3.75 in length; depth 2.75; eye 3 in head, equal to interorbital space; dorsal XIII, 11; anal II, 11; scales 2-16-9.

Body, oblong, compressed; snout rounded; a single row of fine compressed teeth in each jaw; preorbital narrow, about one-half as wide as pupil, its margin smooth and rounded; margin of preopercle smooth; head, excepting snout, scaled; depth and length of caudal peduncle equal, and equal to post-ocular part of head; fourth dorsal spine 1.50 in head; the soft rays of dorsal much longer, about equal to head; pectoral equal to head; ventral prolonged into a filament which reaches beyond origin of anal; caudal more or less rounded.

Color in spirits a deep slaty blue black; the belly abruptly yellowish white; a distinct black spot on posterior base of soft dorsal at axil; an indistinct black line extending back from the posterior of orbit; dorsal fin washed with yellowish white and having a distinct black margin which extends out to tip of fin; the lower half of fin blue; caudal yellowish white; the upper ray black; anal yellowish; ventral yellowish. Some specimens have a wash of dusky on base of anal and base of caudal.

The female fish is without the dark margin to dorsal and caudal, the fins being uniform yellowish white in spirits.

Life colors of various specimens were noted as follows:

(1) From Apia. Deep sapphire-blue or ultramarine; no spots; belly abruptly golden; dorsal brilliant scarlet, the last rays bluish with a small dark spot in axil; caudal dull bluish; anal orange; ventral orange; pectoral blue; a dark stripe through eye and a median one on top of head; these and the dorsal ocellus more distinct in the young.

(2) From Apia. Deep sky-blue; belly abruptly greenish yellow; a black stripe from snout to dorsal above; a black stripe from snout through eye to beginning of lateral line; spinous dorsal brilliant scarlet; soft dorsal pale brownish, with a large black spot at its base; caudal brownish; anal orange-red, deeper before; ventral orange; pectoral purplish, rather dark.

(3) From Pago Pago. Violet-blue, almost uniform above; belly abruptly orange-yellow; a black median streak above head; black streak through eye and snout; black streaks and dots on side of head and shoulder; first dorsal uniform scarlet; second dorsal duller, with large jet-black spot at base; caudal bluish, slightly tinged with orange; ventral and anal orange-red; pectoral dusky; no axillary or opercular spot; side with numerous fine yellow spots visible under lens.

(4) From Pago Pago. Vivid deep blue, the belly and throat from chin abruptly yellow; a narrow black streak through snout and eye up and back to shoulder; a large black spot at base of soft dorsal; spinous dorsal deep scarlet, the soft dorsal and caudal pale bluish; anal and ventrals scarlet; pectoral plain; no spots on axil or opercle.

(5) From Apia. Deepest azure blue, finely dotted with golden on sides; belly whitish; spinous dorsal light vivid scarlet, dusky at base; soft dorsal pale blue, with a large black non-ocellated spot on base, the anterior edge scarlet; caudal pale blue; pectoral same; ventral and anal scarlet.

The specimen of *Abudefduf azureus* figured by Quoy & Gaimard, from Guam, probably belongs to *Abudefduf taupo.* The original type of *Abudefduf azureus*, earlier called *Abudefduf cyaneus* by the same writers, is from Timor. This species, *Abudefduf cyaneus*, is not yet known from the South Seas.

This most beautiful little fish differs from *A. uniocellatus* in the scarlet spinous dorsal fin. About eight specimens were taken at Apia and Pago Pago.

In company with *Pomacentrus pavo*, *Abudefduf uniocellatus*, and other dainty blue species, this fish is known as *taupo* (damsel, village belle) at Samoa.

The type specimen is no. 51741, U. S. National Museum, from Apia, length 2.50 inches.

864. Abudefduf filholi (Sauvage). Fiji.

Glyphisodon filholi Sauvage, Bull. Soc. Philom., 1879, III, 207, Fiji.

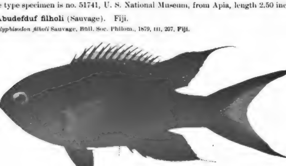


FIG. 51.—*Abudefduf metallicus* Jordan & Seale, new species. Type.

865. Abudefduf metallicus Jordan & Seale, new species. *Pipi.* Samoa.

Head 3.50 in length; depth 2.50; eye 3.25 in head; interorbital 2.80 in head; snout equaling two-thirds of eye; dorsal XIII, 10; anal II, 11; scale 2–17–7.

Body elongate, compressed, the profiles evenly curved; head rounded; preorbital narrow, about one-half the width of pupil, and very short, ending under anterior third of eye; preopercle not toothed; opercle without spines; head entirely scaled except in front of nostrils; mouth small; a single row of small compressed teeth in each jaw; tips of all the fins except pectorals prolonged more or less into filaments; length of fifth dorsal spine 1.75 in head; pectoral equal to head; filament of ventrals reaching to base of anal, the length of the ordinary rays being much less, 1.20 in head; mid-caudal ray 1.20 in head, the outer caudal rays greatly prolonged.

Life colors of a specimen from Apia (elongate, with all fins produced), blue-black, paler below; a black bar across base of pectoral; no other marks; fins all dusky-edged in a larger specimen apparently the same.

Color in spirits, violet black, lighter below; a distinct black base to pectorals; fins blackish, the pectoral and inner part of caudal lighter; the ventrals with slight wash of bluish.

Of this beautiful species, allied to *Abudefduf cochinchinensis* of Day, we have about ten examples from Apia. The type is no. 51742, U. S. National Museum, length 3.30 inches.

DASCYLLUS Cuvier.

Dascyllus Cuvier, Règne Animal, ed. II, 1829a (*aruanus*).

Tetradrachmum Cantor, Malayan Fishes, 240, 1851; substitute for *Dascyllus* on account of the prior *Dascillus* Latreille, 1796, a genus of *Coleoptera*.

866. **Dascyllus aruanus** (Linnæus). *Mamo.* Samoa; Tonga; Tahiti; Fiji; Guam; New Guinea; Woodlark I.; Marquesas Is.; Shortland I. and Raiatea (Seale); East Indies.

This beautiful little fish is excessively common in the crevices of the coral reefs about Samoa. About 200 examples were taken by us. It is generally diffused from Polynesia to the Red Sea, but it does not occur about Hawaii. In life it is grayish dove-color with jet-black cross-bands.

867. **Dascyllus melanurus** Bleeker. Ponape; Shortland I. (Seale); East Indies.

868. **Dascyllus trimaculatus** (Rüppell). Samoa; Louisiades; Aneiteum; New Guinea; East Indies.

Of this widely diffused species we obtained three specimens in Samoa. Life colors of a specimen from Pago Pago, dusky purplish, the scales dark edged; ventral outline and caudal peduncle brassy; dorsal black, with a row of golden spots; soft dorsal rather pale; caudal and anal bleached and golden; ventral black, some golden; pectoral yellowish, a black axillary spot; a round white spot on each side of back, distinct in our specimens, but very faint in others examined, from the Philippines.

869. **Dascyllus albisella** Gill. Hawaii.

This species is rather rare about the Hawaiian Islands, and has never been seen elsewhere. It is very close to *Dascyllus trimaculatus*, but it has a white vertical bar where the latter species has a white spot.

870. **Dascyllus reticulatus** (Richardson). Kandavu; New Britain; Ponape; New Guinea (Macleay).

Heliases reticulatus Richardson, Ich. Chin., 254, 1838, **Canton.**

Tetradrachmum reticulatum, Bleeker, Pomacentridæ, 145, 1877, East Indies, generally common.

Dascyllus xanthosomus Bleeker, Banda, I, 247, **Banda.** Günther, Cat., IV, 14, Borneo. Günther, Fische der Südsee, 237, Kandavu, New Britain, Ponape.

Pomacentrus unifasciatus Kner, Denk. Ak. Wiss. Wien 1869, 348, taf. 8, fig. 24, **Kandavu.**

This species of the East Indies was not taken by us.

871. **Dascyllus unifasciatus** (Kner).

Pomacentrus unifasciatus Kner, Sitz. Ak. Wiss. Wien 1868, 348, taf. 8, fig. 24, **Kandavu.**

This species is unknown to us. It is evidently very close to *Dascyllus reticulatus*, perhaps the same species.

CHROMIS Cuvier.

872. **Chromis cœruleus** (Cuvier & Valenciennes). *I'a lanu-moana; Tealea; Mamo.* Samoa; New Guinea; Ulea; Palau I.; Paumotu I.; Yap; Kingsmill I.; East Indies. (Pl. XLIV, fig. 1.)

Heliases cœruleus Cuvier & Valenciennes, Hist. Nat. Poiss., V, 497, 1830, **New Guinea, Ulea**; said to have 13 dorsal spines.

Heliases frenatus Cuvier & Valenciennes, op. cit., 498, **Guam**; said to have 13 dorsal spines.

Heliases lepisurus Cuvier & Valenciennes, op. cit., 498, **New Guinea.**

Chromis lepisurus, Bleeker, Pomacentridæ, 164; Atlas, 408, fig. 7, Cocos, Java, Celebes, Sumbawa, Flores, Aru, New Guinea.

Glyphisodon bandanensis Bleeker, Ichth. Bijdr. Banda, Nat. T. Ned. Ind., II, 248, **Banda.**

Heliases frenatus, Bleeker, N. Bijdr. Ich. Ceram., ibid., 710; perhaps not of Cuvier & Valenciennes.

Cantharus cæruleus, Cuvier & Valenciennes, op. cit., V, 342.

Heliases cæruleus Bleeker, Vierde Bijdr. Ichth., Kokos-eil; Nat. T. Ned. Ind., VIII, 455.

Heliases lepidurus, Günther, Cat., IV, 63. Günther, Fische der Südsee, 238, taf. 128, figs. C and D, Palau, Paumotu Is., Yap, Kingsmill I.

Glyphisodon anabatoides Day, Proc. Zool. Soc., 1870, 696, **Andaman Is.**

Glyphisodon amboinensis Seale, Bishop Museum, 1901, 84, Guam; perhaps not *H. amboinensis* of Bleeker.

This beautiful species is very common about Samoa, where about 100 specimens were taken in pools on the reefs. With a general blue-green coloration usually with small yellow dots, there is considerable minor variation in the markings in this species. The pale blue frenum is probably never wholly wanting, although much more conspicuous in some specimens than others.

Life colors were noted in various specimens as follows:

(1) From Pago Pago. Vivid steel-green, becoming violet-blue in spirits, silvery below; faint bluish lines along sides of belly; fins all bluish; a large black spot on base of pectoral; a narrow clear blue streak before eye; ventral sometimes pale, sometimes dusky; no other marks.

(2) From Apia; called *mamo.* Clear sky-blue with a strong greenish tinge, whitish below; no yellow, orange or brown; side with 5 or 6 dark blue streaks like pencil marks along rows of scales; axil with a blue-black spot; first dorsal deep bluish; caudal gray, with a bright blue stripe along each lobe; other fins bluish.

(3) From Apia; called *i'a lanu-moana* or blue-fish, scales 25. Vivid sky-blue with bright reflections; finely dotted with black and with fine golden yellow spots, about one for each scale; belly white; fins plain, like body; ventral darker; chin blue.

(4) From Apia. Vivid sky-blue, growing paler below; usually with small yellow dots anteriorly; axil black; spinous dorsal blue black; soft dorsal and caudal mostly bright orange; anal vivid blue; axil black; ventral pale; pectoral dusky.

(5) From Pago Pago. Clear blue-green, silvery below; some specimens rather green, others blue; three pale blue streaks on side of body; base of pectoral dusky; back of caudal peduncle deep green; fins dusky, without blue.

(6) From Pago Pago. Light blue; darker violet-blue on shoulder; whitish blue below golden on caudal peduncle and below base of second dorsal; a black axil spot; fins all dusky blue, some yellow on second dorsal; pectoral almost colorless; ventral posteriorly blackish

The nominal species *cæruleus* and *frenatus* are doubtless identical with *Chromis lepisurus*, in which case the name *cæruleus* has precedence. The type of *cæruleus* is said to have 13 dorsal spines, while *Chromis lepisurus* has 12. No other difference appears in the description. *Chromis frenatus* has a more distinct blue stripe from the snout to the eye, and the caudal lobes less produced. Both these characters are seen in young specimens. In some of our specimens especially, but not always the smaller ones, there is a sharply defined narrow blue streak from eye to snout, as in *frenatus.* In others there is a faint pale streak, and in some a dark streak a little lower down, or on the lower edge of the pale streak.

In response to a request to reexamine the original types of these species, Dr. Léon Vaillant writes (October 12, 1904):

> Les types de *Heliases* (ou *Chromis*) *cæruleus, frenatus* et *H. lepisurus* sont dans un etat de conservation qui en permet facilement l'etude. Il y'a quatre exemplaires du *Chromis lepisurus* venant de la Nouvelle Guinée (No. 8754) deux du *Chromis cæruleus* de la meme localite (No. 5644) sept du *Chromis frenatus* de Guam. (5744 et A 253.) Tous les animaux ont ete rapportes par Quoy & Gaimard. Ce sont les types de l'Histoire des Poissons.
>
> "Les caractères donnes par les autores de ce travail étant du caractère de coloration ne se retrouvent guère sauf par le trait argentée qui va de l'oeil au museau, quon voit tres distinctement, et sur toutes les exemplaires du *Chromis frenatus* mais en ce que tous les exemplaires sont sensiblement plus petit que ceux des deux autres espèces, ce pouvait etre un caractère de jeune age, une sorte de livrée neoterique.
>
> "À premiere vue, ce *Chromis frenatus* m'avait paru assez different des *Chromis lepisurus* et *Chromis cæruleus* pour lesquelles l'identification ne sauriat pas faire de doute, mais en prenant les dimensions exactes et les reduisant proportionellement a les longueurs donnés, j'ai pu me convaincre que les differences de proportions n'etaient que apparent et dues a les difficultés qu'on epreuve de comparer des exemplaires. . . .
>
> "En résumé, je partage tout a fait votre avis et pense comme vous que ces trois espèces n'en font qu'une, a peine serait on autorise a regarder le *Chromis frenatus* comme une variété."

Dr. Vaillant notes that the caudal angles are more prolonged in the specimens called *Chromis lepisurus*, but a table of measurements sent by him shows no important difference in proportions.

873. Chromis analis (Cuvier & Valenciennes). *I'a lamu-moana.* New Guinea (Macleay); Samoa; East Indies.

This well-marked species is common at Samoa, where about 25 specimens were taken. Life colors of a very deep specimen from Apia, pale blue, light golden behind and on soft dorsal, anal, and caudal; sides with a few narrow bronze lines; ventral white, dusky-edged, very long; caudal, dorsal, and especially anal dark-margined; a little dusky shade at base of soft dorsal and anal behind; iris blue; a dark speck in pectoral axil.

874. Chromis ovalis (Steindachner). Hawaii.

875. Chromis elaphrus Jenkins. Hawaii.

876. Chromis dimidiatus (Klunzinger). Tahiti; Raiatea; East Indies.

Heliastes dimidiatus Klunzinger, Fische Rothen Meeres, 529, **Red Sea.**
Heliastes dimidiatus, Günther, Fische der Südsee, 237, taf. 125, fig. B, Tahiti, Raiatea.

This species was not seen by us. It is very close to our *Chromis iomelas*, but according to the figure of Dr. Günther, and the description of Dr. Klunzinger, the posterior boundary of the black area is at the front of the anal fin.

877. Chromis iomelas Jordan & Seale, new species. Samoa.

Head 3.30 in length; depth 2; eye 2.10 into head, equal to interorbital; dorsal XII, 11; anal II, 12; scales 2½-16-8.

Body rather deep and stout; head scaled, except between and in front of nostrils; teeth small, in several rows on each jaw; caudal peduncle short, its length equal to its depth; preorbital narrow, equal to about one-half of pupil; fourth dorsal spine about equal to postocular part of head; lobes of caudal prolonged into filaments; pectoral fin slightly longer than head; filaments of ventral reaching to base of anal.

Life colors, specimen from Pago Pago, anteriorly deep brownish black, abruptly pale lavender behind, the color deepest anteriorly; a large black ocellus on base of pectoral; fins colored like rest of body, the elongate caudal very pale lavender, the elongate ventral black.

In preserved specimens anterior from a line with base of fifth dorsal spine vertically down, the color is brown; all posterior to this line is yellowish white; base of pectorals black; ventrals black; four anterior dorsal spines black, the remainder of dorsal yellowish white; caudal and anal yellowish white.

This species is very close to *Chromis dimidiatus*, but the lavender-colored caudal region begins much in front of the anal fin. Three specimens were taken at Pago Pago. The type is no. 51743, U. S. National Museum, from Pago Pago; length 2.25 inches.

878. Chromis axillaris (Bennett). Raiatea (Seale); East Indies.

ACANTHOCHROMIS Gill.

Heptadecacanthus Alleyne & Macleay, Proc. Linn. Soc. N. S. W. 1876, 343 (*longicaudus*).

879. Acanthochromis polyacanthus (Bleeker). Faté and New Hebrides (Seale); East Indies.

Family LABRIDÆ.

CHŒROPS Rüppell.

880. Chœrops anchorago (Bloch). Palau; Yap; New Hanover (Peters); New Guinea (Macleay).

(*Chœrops macrodontes* Lacépède.)

Chœrops meander Cartier, from the Philippines, is doubtless the young of this species.

881. Chœrops brenchlyi Günther. Misol.

Chœrops brenchlyi Günther, Ann. Mag. Nat. Hist., 1872, 274.

882. Chœrops cyanostolus (Richardson). New Guinea (Macleay); Australia; East Indies.

Cossyphus ommopterus Richardson, probably not *Chœrops schoenleini* of Bleeker; certainly not *Cossyphus schoenleini* Agassiz.

According to Günther, the stuffed skin which is type of *C. cyanostolus* Richardson belongs to the species called *C. ommopterus* by Richardson, on the next page. This species is characterized by the black dorsal spot, which seems to be wanting in the true *Chœrops schoenleini*. *Chœrops schoenleini* of Bleeker has this spot, but also a pale spot beyond it, wanting in *C. cyanostolus*. This seems to be the same as *Chœrops unimaculata* of Cartier.

883. Chœrops cyanodus (Richardson). Tahiti; Australia.

VERREO Jordan & Snyder.

884. Verreo oxycephalus Bleeker. Hawaii; New Guinea; Australia; Japan.

VERRICULUS Jordan & Evermann.

885. Verriculus sanguineus Jordan & Evermann. Hawaii.

LEPIDAPLOIS Gill.

886. Lepidaplois axillaris (Bennett). New Hebrides; Ulea; Tahiti; Paumotu Is.; Guam; East Indies.

887. Lepidaplois hirsutus (Lacépède). Vavau (Günther); East Indies.

888. Lepidaplois albotæniatus (Cuvier & Valenciennes). Hawaii; Johnston I.

This species, very abundant about Hawaii, was not taken by us at Samoa. It reaches a considerable size, and is subject to some changes in color with growth.

We can not identify the Hawaiian species with *Lepidaplois bilunulatus* of the East Indies. The latter species, according to Bleeker's figure, has two broad, black curved stripes on the head, instead of the narrow maroon streaks seen in our species. The incomplete account given by Cuvier bears out this probable difference.

889. Lepidaplois strophodes Jordan & Evermann. Hawaii.

This species, thus far known from small specimens only, is occasionally taken about Hawaii. The black blotch at base of soft dorsal behind extends across the body, forming a broad black bar. This species is probably not the young of *Lepidaplois albotæniatus*, as supposed by Günther, as we have specimens of the latter of about the same size as the types of *strophodes* which have the characteristic markings of the adult. Still it is possible that these are acquired by some examples at an earlier stage than by others.

890. Lepidaplois modestus (Garrett). Hawaii.

891. Lepidaplois perditio (Quoy & Gaimard). Tonga; Saumarez Reefs; Aneiteum; Japan; Mauritius.

NESIOTES De Vis.

892. Nesiotes purpurescens De Vis. South Seas.

Nesiotes purpurescens De Vis, Proc. Linn. Soc. N. S. W. 1884, 453. **South Seas.**

LABROIDES Bleeker.

893. Labroides dimidiatus Cuvier & Valenciennes. Samoa and Hawaii (Günther); Palau; Yap; New Hebrides; East Indies.

This species was not taken by us.

894. Labroides paradiseus (Bloch). New Guinea (Macleay); East Indies.

DUYMÆRIA Bleeker.

895. Duymæria cæruleomaculata Günther. Aneiteum; New Hebrides.

896. Duymæria nematoptera Bleeker. New Guinea (Macleay); East Indies.

PSEUDOLABRUS Bleeker.

897. Pseudolabrus unilineatus Guichenot. Guam.

This species is perhaps the type of a distinct genus.

LABRICHTHYS Bleeker.

Labrichthys Bleeker, Flores, 331, 1854 (*cyanotænia*).
Thysanochilus Kner, Denks. Ak. Wiss. Wien, XXIV, 1865, 5 (*ornatus*).
Chœrojulis Kner & Steindachner, Sitz. Ak. Wiss. Wien, LIV, 1867, 393 (*castaneus*); not of Gill.

898. Labrichthys cyanotænia (Bleeker). *Sugale uliuli.* Samoa; East Indies.

Labrichthys cyanotænia Bleeker, Bijdr. Ichth. Flores, Nat. T. Ned. Ind., VI, 331, 1854, **Flores.**
Thysanochilus cyanotænia Günther, Fische der Sudsee, 242.
Thysanochilus ornatus Kner, Denks. Ak. Wiss. Wien, XXIV, 1865, 5, taf. 3, fig. 1, **Samoa.**
Platyglossus ocellatus (or *Platyglossus chrysotænia* var.) Kner & Steindachner, Sitz. Ak. Wiss. Wien, LIV, 1867, 377, **Upolu.**
Chœrojulis castaneus Kner & Steindachner, op. cit., 393, fig., young, Upolu, same specimen as *Platyglossus ocellatus.*

We have 8 specimens of this dainty fish from Apia. It is notable for its small mouth and very wide lips. There is a posterior canine tooth and 9 dorsal spines.

Life colors of a specimen called *sugale uliuli*, dark brown, almost black, with obscure stripes of bronze and blue, very dark, and therefore faint; a black spot at base of pectoral; head with wavy blue stripes, lips yellow; dorsal colored like body, with blue edge; anal with blue edge and blue median stripe, elsewhere dark bronze; caudal like body at base, with blue curved streak, posterior part black, the edge pale; ventral blue, with black stripe; pectoral dusky greenish yellow at base.

Another specimen from Apia was jet black, with two white longitudinal streaks, the upper from end of snout to base of caudal, the other from throat alongside of belly to middle of anal; mouth golden; fins black, the caudal white edged.

899. Labrichthys australis Steindachner. South Seas.

Labrichthys australis Steindachner, Ichth. Mitth., VIII, 1866, 476, **South Seas.**

EPIBULUS Cuvier.

900. Epibulus insidiator (Pallas). *Lapega; Gutu-ume.* Samoa; Tahiti; New Guinea; Raiatea and Faté (Seale); East Indies.

This singular fish, which early attracted attention, is common about Samoa. We have 49 examples from Apia and 10 from Pago Pago, and these well illustrate the wide variation in color exhibited by this fish, it being dichromatic, some individuals bright yellow, others dark olive-brown.

Life colors of a specimen from Apia called *lapega*, dark lemon-yellow, brown on top of head, with vertical bar of blackish on each scale; anal yellow and lower part of head yellow; spinous dorsal brownish, yellow at base, then greenish yellow, then brownish red, then green, then orange-brown; a deep blue spot on front of dorsal, with orange below it.

Young very dark brown; a blue spot followed by yellow on front of dorsal.

HEMIGYMNUS Günther.

901. Hemigymnus melapterus (Bloch). *Alati moana; Paumutu; Afataimi; Tagitagi; Sugale uli; Sugale aloa.* Samoa; Palau Is.; Ponape; New Guinea (Macleay); Shortland I. (Seale); East Indies.

This is a very common fish about Samoa. We have 14 examples from Pago Pago and 24 from Apia. The coloration changes with age in a marked degree. In the young the anterior half of the body is largely white.

Life colors of a specimen from Apia, called *afataimi*, or *tagitagi*, dark brownish olive; most scales brown at base, with violet blue spot mostly obscure; head dark, the cheek bright yellow, the space behind eye coppery; head everywhere with vermicular streaks, green above, blue below; lips and chin dirty grayish, unmarked; dorsal brownish red, with blue spots and two blue marginal streaks, the lower violet blue and broader; caudal dirty blue, the rays blue, the margin dirty brown; anal dull blue, with many round blue spots and a blue stripe, the edge brownish; ventral whitish, with dull orange on first soft ray, and yellow and orange dashes behind; pectoral pale, the axil golden, the upper ray and a bar across base blue, the latter with golden and bluish edge behind; lips very thick; some scales on cheek. A smaller example has the ventrals brighter, orange and blue; otherwise it is the same.

Another specimen from Apia, a large one, was uniform blackish green, the scales showing traces of green and violet markings when examined closely; belly bronze brownish, with a violet spot on each scale, these violet shades scattered over the sides; cheek and interopercle clear olive green; lips dusky olive; a bright grass-green ring about eye; a dull dark blue blotch behind eye; preorbital, suborbital, lower and upper part of cheek and opercle dull bronze-orange with sharp vermiculations; throat reddish gray; dorsal blackish, orange, very dark, with a dark blue edge and a dark blue stripe below; many deep violet spots on membranes; caudal violet blackish, shaded with green on rays and edged with dull orange; violet spots and vermiculations; anal dusky orange, a deep violet blue intramarginal band, and with deep violet spots; ventral orange, with large blue spots; pectoral dusky bluish, paler below.

A specimen called *alati moana*, from Apia, was deep blue black with olive shades behind front of first dorsal and vent; shoulder light green with dull orange spots, the shade becoming golden olive behind gill-opening and on opercle and cheek; the breast, throat, and belly gray; pink shades on opercle; a pink stripe below eye; a large violet-coppery blotch behind eye, with deep violet spots within, these having paler centers; forehead coppery violet, mottled with green; bright blue close behind eye; dorsal violet black, with green on basal scales, then bright blue marblings anteriorly; violet-blue spots on membranes, with marginal stripes of deep violet-blue, light pinkish brown and black; caudal olive-black, with a median narrow stripe of violet-blue from base to tip; anal brown suffused with blue, with violet-blue spots, and blue, pinkish, and black edgings; ventral colorless, olive-shaded, the anterior rays pink, margined before and behind by dusky blue; pectoral colorless, the upper edge blue. Canines 2-2; no posterior canines; a few scales on cheek; lateral line continuous.

Life colors of a specimen called *paumutu*, from Apia, posterior parts, behind middle of pectoral, deep brownish black; anterior parts abruptly soiled gray; dark brown on top of head, with bluish reticulations; upper lip gray, lower whitish; a whitish undulate streak below eye; axil black; dark brown spots about eye; dorsal dark brown, lighter above with streaks of bluish; anal similar, with a blue stripe and an orange margin; caudal with peduncle light brown, spotted with blue; pectoral colorless; ventral tinged with orange.

902. Hemigymnus fuliginosus (Lacépède). Samoa; Carolines; New Guinea (Macleay); East Indies.

Mullus fasciatus Thunberg, Reise nach Japan, IV, 1791, 351, pl. 314, City of "Meaco" (doubtless Miyakoshima, Temple I., one of the Riukiu group); not of White, 1790, which is a species of *Amia*.
Sparus fuliginosus Lacépède, Hist. Nat. Poiss., III, 437, 1802, **Ile de France.**
Sparus malapteronotus Lacépède, op. cit., 450, **Ile de France.**
Sparus zonephorus Lacépède, Hist. Nat. Poiss., IV, 155, 1803; after Bloch.
Sparus meaco Lacépède, op. cit., 161; after Thunberg.
Sparus quinquefasciatus Bennett, Fishes Ceylon, 1839, pl. 23, **Ceylon.**
? *Tautoga mertensi* Cuvier & Valenciennes, Hist. Nat. Poiss., XIII, 308, 1839; Carolines.
Cheilinus blochi Cuvier & Valenciennes, Hist. Nat. Poiss., XIV, 1839, 108; after *Labrus fasciatus* Bloch.
Tautoga leucomus Bleeker, Biliton, IV, 239, **Biliton**; young.
Hemigymnus leucomus Gunther, Cat., IV, 139, 1862.

Of this species we have one large specimen from Apia. The name *fasciatus* is not tenable for it, having been preoccupied.

ANAMPSES Cuvier. *Sugale.*

903. Anampses cuvieri Quoy & Gaimard. Hawaii.

904. Anampses cæruleopunctatus Rüppell. *Sugale lupe.* Samoa; Tahiti; Guam; New Guinea (Macleay); Rarotonga (Seale); East Indies.

This species is not uncommon in the South Seas. We have 9 specimens from Apia.

Life colors of a specimen called *sugale lupe*, olive, the belly gradually scarlet; each scale with a violet-blue spot, edged with blackish blue, these confluent into streaks behind and below eye; dorsal orange-brown, spotted with blue and blue-edged; caudal like body, the spots smaller, the edge dusky and then whitish; anal bright orange-brown, spotted with blue and with blue edge, the lowest (basal) row of blue spots oblong; ventral orange streaked with blue; pectoral yellowish; dark brown at base.

905. **Anampses evermanni** Jenkins. Hawaii.

906. **Anampses godeffroyi** Günther. Hawaii.

Anampses godeffroyi Günther, Fische der Südsee, 252, taf. 140, 1873, **Sandwich Is.**

This species is described from a drawing made by Garrett at Hilo. We have specimens from Hawaii corresponding to this drawing, but they seem to us only highly colored examples of the species called *Anampses evermanni*. Doubtless the two are identical.

907. **Anampses diadematus** Rüppell. Samoa (Günther); Paumotu Is.; Kingsmill Is.; Huahine; Misol; East Indies.

908. **Anampses neoguinaicus** Bleeker. New Guinea.

Anampses neoguinaicus Bleeker, Archiv. Neerl. 1878, 57.

909. **Anampses melanurus** Bleeker. Savaii.

Anampses melanurus Günther, Fische der Südsee, 252, Amboina.

910. **Anampses pterophthalmus** Bleeker. New Guinea (Macleay); Oualan (Günther); East Indies.

911. **Anampses fidjiensis** Sauvage. Fiji.

Anampses fidjiensis Sauvage, Bull. Soc. Philom. 1880, 224, **Fiji.**

AMPHECES Jordan & Evermann.

912. **Ampheces geographicus** (Cuvier & Valenciennes). New Guinea (Macleay); East Indies.

STETHOJULIS Günther.

913. **Stethojulis strigiventer** Bennett. Samoa (Günther); Palau; Fiji; Vavau; Ponape; New Guinea; East Indies.

914. **Stethojulis fulvoventris** Seale. Guam.

915. **Stethojulis renardi** Günther. Samoa (Günther); Guam; Ponape; East Indies.

916. **Stethojulis albovittata** (Kölreuter). Hawaii.

This species is common about the Hawaiian Islands. It is not certainly known from elsewhere, though Günther lists it from Zanzibar and Madagascar. It is well separated from *Stethojulis casturi*, its representative in Polynesia and the East Indies.

917. **Stethojulis casturi** Günther. Samoa; Palau Is.; Futuna; New Guinea; Rarotonga (Seale); East Indies. (Pl. XLV, fig. 1.)

Stethojulis albovittata, Bleeker, Atlas, 132, tab. XLIV, fig. 5, East Indies; not of Bonnaterre.
Stethojulis casturi Günther, Fische der Südsee, 255, 1873, **Palau, Futuna, Yap.**

We have 10 specimens of this fish from the coral reef at Apia. It is readily distinguished from *Stethojulis albovittata*, with which it has been confounded, by the presence of but one stripe extending the whole length of the side. In *Stethojulis albovittata*, which is known from about Hawaii only, there are two bluish stripes from pectoral to caudal, and the interspace between them is red.

Life colors of a specimen of *S. casturi* from Apia, violet-black; abruptly livid bluish white below; a sharp boundary stripe bright sky-blue, widened behind and bordered below by pale golden; head olive green, clear on sides; four curved unequal stripes on head, sky-blue with darker edgings, (1) one above eye, including its upper edge, extending along back to last ray of dorsal, (2) a violet line behind eye to above gill-openings, (3) from angle of mouth to lower part of eye, curving above axil and becoming the blue lateral stripe on body; lowest stripe curving across cheek to join its fellow on the chin. A long crescent of vivid scarlet, including the axil. Edge of shoulder-girdle below it deep blue; dorsal dull brownish gray; caudal grayish, the median blue streak extending on it; ventral and anal colorless, pectoral also.

918. **Stethojulis trilineata** (Bloch & Schneider). New Guinea (Macleay); New Hanover (Peters); Palau Island (Günther); East Indies.

919. Stethojulis phekadopleura Bleeker. Samoa; Solomon Is.; Ponape; New Guinea (Macleay); East Indies.

This is a common species in the East Indies; it also occurs abundantly in the South Seas. We obtained 14 examples at Pago Pago and 54 at Apia. We have also examined specimens from Negros in the Philippines.

Life colors of Samoan specimens were noted as follows:

(1) From Apia. Back clear olive-brown with rows of bluish white dots; belly abruptly white, a golden brown boundary stripe widening into a grayish stripe below eye, edged above with a fine white line; the boundary stripe faint with age; belly with 3 or 4 rows of blackish brown spots, one in each scale; base of anal livid blue; a large black spot at base of caudal, surrounded by orange-brown (fainter and more diffuse in old examples, in which the gray stripe below eye is lost, the pale line above it remaining distinct); dorsal orange, dull with bluish and orange spots; caudal dull orange and livid bluish; ventral same, as is also the anal; pectoral colorless; iris reddish; axil unmarked. The lack of axil markings, the white dots above and dark below are characteristic.

(2) From Pago Pago. Green olive above; livid silvery below, brownish above posteriorly; head and all upper parts finely dotted with pale bluish; lower parts with larger dark brown spots in 4 rows; a pinkish white stripe before eye; a black spot on base of caudal above, faint in adult; fins all pale brownish red, the dorsal very finely checked; a pinkish streak below eye, breaking into spots behind; anal livid bluish.

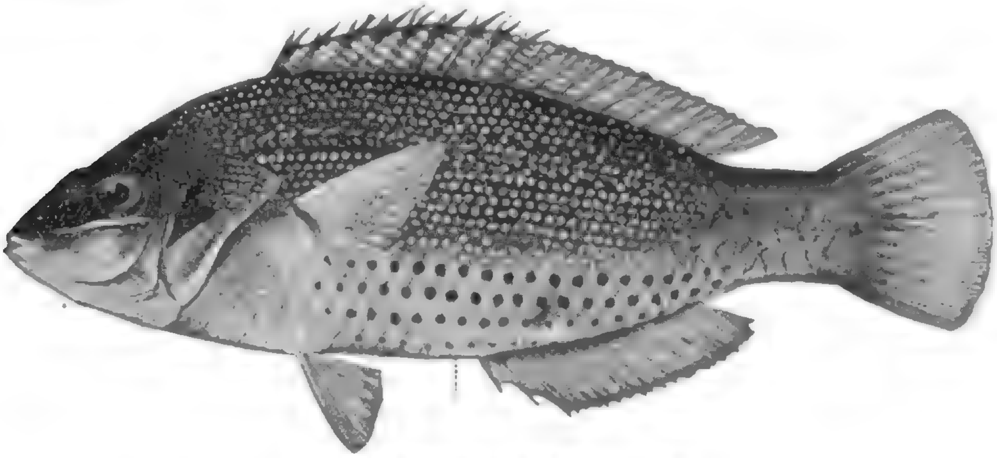


FIG. 52.—*Stethojulis phekadopleura* Bleeker.

(3) From Pago Pago. Very finely dotted above, coarsely spotted below; no axil or caudal spot; a silvery streak below eye; fins reddish; dorsal much speckled.

(4) Very young; from Pago Pago. Bright reddish brown with a pale streak below eye and another from snout above eye along side of back; bluish spots on scales and some black ones on side of belly; a black spot at base of caudal and another on upper fin rays; caudal colorless; other fins orange.

920. Stethojulis axillaris Quoy & Gaimard. Hawaii.

This species, as understood by us, is found only about the Hawaiian Islands, where it is rather common. Farther south it is represented by a marked subspecies or closely related species, with slenderer body and paler lower parts, *Stethojulis bandanensis* of Bleeker. It is barely possible that larger series may show the two to be identical, as supposed by Bleeker and Günther.

921. Stethojulis bandanensis (Bleeker). Samoa; Palau Is.; Solomon Is.; Fiji; Tahiti; New Hebrides; Ponape; New Guinea. (Pl. XLV, fig. 2.)

Julis bandanensis Bleeker, Banda, I, 254; Banda.

Stethojulas axillaris Bleeker, Atlas, Labr., 136, tab. XLIV, fig. 3, 1862, East Indies; not of Quoy & Gaimard. Günther, Fische der Sudsee, 254, taf. 136, fig. c. Palau, Solomon, Fiji, Samoa, Society Is., New Hebrides, Ponape.

This species has been confused with *Stethojulis axillaris* (Quoy & Gaimard), of Hawaii, to which it is closely related. The only tangible differences are these: *Stethojulis axillaris* has the body deeper, and the belly is not very pale, its coloration not sharply separated from that of the sides. *Stethojulis bandanensis* is a slenderer fish, and the belly is abruptly whitish, with a dark shade on each scale.

This species is very common about the coral reef at Apia, where we obtained 55 specimens. We also collected 9 at Pago Pago. Life colors of a specimen from Apia, gray, silvery on lower half; everywhere with fine lengthwise streaks of white, these broader and more conspicuous below, especially the one below eye, which has a dark streak above it; a small jet-black spot in axil of dorsal and one on upper part of caudal peduncle just before base of caudal; fins all pale (in young of 2 inches).

A specimen from Pago Pago was olive-green, posteriorly purplish; cheek abruptly golden; anterior region with fine pale dots; whitish pink spots along side; a white spot across base of pectoral; a black ocellus on last rays of dorsal, anal and base of caudal; fins otherwise light orange. Another specimen has three caudal ocelli.

Another specimen from Apia has its upper half grayish dusky with very fine bluish-white dots; a grayish lateral band, edged with dark above, a broad metallic purplish gray band below it, the belly silvery, each scale with a dark purplish-gray basal spot, two black pale-blue-edged ocelli on caudal peduncle, a black bar across base of pectoral, a bright scarlet dash in axil, with blue on each side of it; side of head below eye abruptly golden; chin and throat white; dorsal golden brown, finely dotted; caudal dull yellowish; ventral, pectoral, and anal colorless, belly livid blue at base of anal.

922. Stethojulis filholi Sauvage.

Stethojulis filholi Sauvage, Bull. Sci. Phil. 1880, 15 (reprint), Fiji.

923. Stethojulis kalosoma (Bleeker). New Guinea (Macleay); East Indies.

LEPTOJULIS Bleeker.

924. Leptojulis pardalis Kner. Fiji; Guam; Samoa. (Pl. XLV, fig. 3.)

Leptojulis pardalis Kner, Sitz. Akad. Wiss. Wien 1867, 727, taf. III, fig. 2 (fig. 9 in text), Viti Levu (Fiji Is.).
Platyglossus nigromaculatus Günther, Proc. Zool. Soc. 1871, 666, pl. 60, Samoa.
Halichœres nigropunctatus Seale, Bishop Museum, 1901, 89, Guam.

We have 4 specimens of this handsome species, taken at Apia. Life colors of one of these, clear olive-green, yellow below; everywhere with reticulations of ground-color, yellow with blue margins around the black; these marks orange-brown instead of black on forehead, lower part of head, and belly; oblique dark stripes from eye around jaws, edged with light blue; dorsal, caudal and anal similarly marked, the brown becoming distally very bright clear orange-brown; ventral yellow, orange banded; pectoral plain; dorsal edge of body clear olive brown; greenish cross-bars on head.

A canine tooth; scales rather large; lateral line continuous; a low dorsal sheath; body compressed.

MACROPHARYNGODON Bleeker.

This well-marked genus consists of small species, deep bodied and beautifully colored, the lower pharyngeals very small, with large teeth.

925. Macropharyngodon geoffroy (Quoy & Gaimard). Hawaii.

926. Macropharyngodon meleagris (Cuvier & Valenciennes). New Guinea; Samoa; Ulea; Shortland I. (Seale); East Indies.

Julis meleagris Cuvier & Valenciennes, Hist. Nat. Poiss., XIII, 481, Ulea.
Macropharyngodon geoffroyi Bleeker, Atlas, Labr., 129, tab. XXXVII, fig. 5, Celebes; not of Quoy & Gaimard.
Platyglossus geoffroyi, Günther, Cat., IV, 145 (copied).

This species is scarce about Samoa, one fine example being taken at Apia. Life colors, violet-brown; a large, bright-green spot edged with blue on each scale, these confluent into short stripes on the head; belly mostly light blue; a violet-black spot on breast; dorsal orange, shaded with bluish at base, edged with gray, two rows of clear green blue-edged spots; caudal dull orange, brighter on upper and lower margins and covered mesially with large greenish-blue spots; anal dull orange with three rows of greenish, blue-edged spots, the middle series confluent in a band; ventral dull orange, spotted with green; pectoral colorless, dusky at base, the axil green; a jet-black spot edged with yellow on side above and a little behind base of pectoral.

PLATYGLOSSUS (Klein) Bleeker.

This genus in very closely allied to *Halichœres*. The body is deeper and more compressed, and the scales along the base of the dorsal more elevated, forming a low sheath.

927. Platyglossus marginatus (Rüppell). Samoa; Raiatea (Seale). (Pl. XLVI, fig. 1.)

Two specimens of this handsome fish were collected by us at Apia. It has not heretofore been found in the South Seas.

Life colors of one specimen, olive-black, region covered by pectoral bright cherry-red; a reddish streak along the edge of each row of scales, these clear brown on back, faint posteriorly and pinkish brown on belly; head golden-brown, much striped with dark blue; belly also blue, striped with brown; dorsal dark orange-brown spotted with dark blue, and edged with sky-blue with a dark blue bounding line; caudal deep orange-brown with dark blue spots and sky-blue edgings; a dark blue bounding line, the angles olive-gray; anal like dorsal but further edged with bright yellowish green; ventral and pectoral dark bluish; axil cherry-red.

928. Platyglossus notopsis (Kuhl & Van Hasselt). Samoa; East Indies.

The young of this fish differs markedly from the adult in having four conspicuous white lines along the side and two or three similarly colored spots below the dorsal. The dorsal, in both young and old, has a small ocellus between the first and second spines, and a very large one between the first and sixth rays.

This is a common fish at Samoa. We have 40 specimens from Apia, and 49 from Pago Pago. Color in life of a specimen from Apia, almost jet-black, with very obscure whitish spots on scales; caudal paler sooty; iris red; pectoral dull olive, a black bar across base; breast and chin purplish black; dorsal, anal and ventral black, the dorsal usually with a large bluish, white-edged ocellus; caudal abruptly pale olive (side with about a dozen greenish pale streaks in younger ones); teeth small, a posterior canine; head naked; body deep, head sharp above; scales large; dorsal uniform.

Another specimen from the same locality was jet-black, with six irregular interrupted whitish lines, plainest on head; dorsal black, with a large white-edged ocellus on first soft rays; caudal abruptly bright white, a whiter stripe along anterior edge; anal and ventrals black.

Life colors of a specimen from Pago Pago, black, with very faint streaks of bluish, scarcely evident and distinct only on head; caudal abruptly muddy white; a large, black, whitish-edged ocellus on first soft dorsal rays, and a little one on first and second spines; dorsal striped throughout with dull orange; anal, ventral, and pectoral plain blackish. This is very close to another that has golden stripes, very distinct. The latter is apparently the young.

929. Platyglossus flos-corallis Jordan & Seale, new species. Samoa. (Pl. XLVI, fig. 2.)

Head 3.20 in length; depth 3.50; eye 4.50 in head; dorsal IX, 12; anal III, 12; scales 2-30-8, interorbital equal to eye; snout 3 in head.

Body oblong, compressed; caudal rather deep, 2.30 in head; head unscaled; mouth somewhat protractile, jaws equal, lips thick; teeth in a single series of sharp, somewhat projecting conical teeth in each jaw, the front ones the largest; a sharp canine tooth at angle of jaws; opercle and preopercle entire; gillrakers very short, sharp, about 13 on lower limb; longest dorsal ray 2.75 in head; longest anal spine 2.80 in head; base of anal equal to length of head; pectoral 1.50 in head; anal rounded, 1.50 in head; ventral equal to length of pectoral, its tips not reaching base of anal.

Color in spirits, a dull yellowish brown with ten longitudinal blue lines on the side from head to caudal; these lines are slightly wider than their interspaces and are most distinct on anterior half of body; the caudal peduncle has a median line of yellowish white on its sides extending in from caudal fin; a bright yellow spot on base and in axil of pectoral with a smaller distinct black spot on upper part of base; head yellowish with two blue lines from interorbital to tip of snout, a blue line from anterior margin of eye to tip of snout, a curved blue line around chin over cheek across opercles to base of pectoral, below which are two indistinct blue lines; just back of orbit is a black spot forming the termination of the 4-5 lines of body; the three upper body lines extend on nuchal region, the second joining the line above, the other terminating at upper posterior margin of orbit; a blue crescent on opercular flap; dorsal with seven longitudinal bands of color, the mid one of greenish white, occupying the middle of the fin, being the widest; a broad, dark green, black-edged stripe just below with light green at base of fin; anal similarly colored, except that the mid-band of light green is wider and there is no lighter coloring at base of fin; caudal yellowish white with the outer half covered with reticulated dark markings, tip of upper and lower margin yellowish white; pectoral and ventral yellowish white.

Life colors of three specimens from Pago Pago were as follows:

(1) Green anteriorly, becoming deep vitriol-blue behind pectorals; anterior parts with stripes of orange-red, which are very bright anteriorly and fade out behind; cheeks golden-green; head stripes very plain; axillary region very bright golden, with a black spot above; dorsal with dull, orange and greenish streaks; caudal blue with pale corners and three orange-red stripes converging and reticulating behind, crossed by horizontal streaks of black; anal with basal and terminal stripes of orange; ventral green with purple stripe; pectoral pale, its base bright golden.

(2) Greenish ground, paler and yellowish anteriorly; ten pinkish salmon longitudinal lines on sides, most pronounced anteriorly. Pectoral with yellowish axil and orange-yellow blotch just behind axil; small but distinct black blotch just in shoulder of pectoral; caudal blue-green at base and mesially with complex linear lines of pinkish salmon, these lines darker in middle portion of fin; dorsal yellowish grass-green with pinkish salmon lines and narrow blue lines; anal similar; ventral bright green with bluish tinge, pinkish salmon on anterior margins; bright blue median longitudinal line on under side of head.

(3) Bronze, with nine sharply-defined lengthwise stripes of greenish blue, as wide as interspaces; a stripe also on median line above and below; head green, yellowish below, the stripes continued on it becoming orange, those below cherry-brown; dorsal brownish orange, with grass-green stripes below and blue lines above and on edge; caudal deep black tinged with red, with blue cross-lines and three green blotches at base; anal orange with one green stripe and four blue streaks; ventral grass-green, blackish-edged; pectoral pale dusky; axil golden; a jet-black spot at base of pectoral.

This beautiful fish is rare about Samoa. We obtained but three specimens, all at Pago Pago. It is apparently close to *Platyglossus kallochromus*, of the East Indies, but there are several notable differences in color.

The type, no. 51744, U. S. National Museum, is 2.75 inches long.

930. Platyglossus hœveni (Bleeker). Samoa; New Guinea (Macleay); East Indies.

We have two examples of this East Indian fish, both from Pago Pago. Life colors of one of these, bright greenish blue, with about a dozen golden stripes, distinct from snout to base of caudal, the interspaces blue, with darker edgings; snout grass-green; iris blue, centrally red; base of caudal reddish brown; a blue-edged black ocellus at base of caudal above, and a larger one on front of soft dorsal; a small one on first dorsal spine; caudal abruptly pale, with a reddish, curved cross-band at base and a whitish bluish one behind it; fins (in young) plain; dorsal striped orange and blue; a dark spot before and one behind eye; snout yellow.

HALICHŒRES Rüppell.

(*Halichœres* Rüppell, type *cæruleovittata-scapularis; Guntheria* Bleeker; *Hemitautoga* Bleeker; *Ichthycallus* Swainson; *Chœrojulis* Gill; *Iridio* Jordan & Evermann; *Parajulis* Bleeker; *Octocynodon* Fowler.)

The proper type of the genus *Halichœres* is a species (*scapularis*) belonging to the group called *Guntheria*. If these sections are regarded as genera, the one commonly called *Halichœres* should rather stand as *Ichthycallus*, or as *Chœrojulis*, if the American species be separated from the others. But it is probably better to leave all the species with large scales, complete lateral line, and a posterior canine, *Platyglossus* and *Macropharyngodon* excepted, together in one large genus.

931. Halichœres scapularis (Bennett). Shortland I. (Seale); East Indies.

? *Halichœres cæruleovittatus* Ruppell.

932. Halichœres centiquadrus (Lacépède). *Ifigi.* Samoa; Guam; New Guinea; Tahiti; Shortland I. and Raiatea (Seale); East Indies. (Pl. XLVI, fig. 3.)

This beautiful fish occurs from the Red Sea throughout Polynesia. We have 3 specimens from Pago Pago and 7 from Apia. Life colors of a specimen from Pago Pago, head grass-green, the stripes creamy pink, edged with blue; jaws yellow; stripes on throat of paler pink.

933. Halichœres notophthalmus (Bleeker). Samoa; New Guinea; Rarotonga (Seale); East Indies.

We have 4 specimens of this East Indian fish taken at Apia. Life colors of one specimen, body gray with transverse blotches of black, very irregular; lips orange; iris red; caudal bright yellow with two confluent white blotches at base, with black between; a white blotch across spinous dorsal; a black ocellus, golden-edged, on soft dorsal; anal and pectoral pale; ventral white; a brown red stripe through eye; whitish stripe below; a brown red spot below; breast mostly black. (Young).

Another specimen was very pale olive, almost white, with three broad black irregular crossbars, the second broadest and blackest, some black spots on the pale bars along line of back; head pale; cheek with two deep blue horizontal stripes, the upper through eye to gill-opening; darker behind eye; two black spots on each side of breast, two on base of pectoral with white between; dorsal colored like body; a large white-edged black ocellus in black part; soft dorsal mottled, pale gray; caudal deep yellow with two whitish yellow spots at base, dusky between; ventral whitish; pectoral colorless; anal pale.

934. Halichœres trimaculatus (Quoy & Gaimard). Samoa; Vanicolo; New Guinea; Fiji; Tahiti; Tubuai; Faté and Shortland Is. (Seale); East Indies. (Pl. XLVII, fig. 1.)

This is a common and most beautiful fish about Samoa, where it swarms in the coral reefs. We have 58 specimens from Pago Pago and 80 from Apia.

Life colors were noted in various specimens as follows:

(1) From Apia. Green, each scale with a dark grayish bronze crescent; scales of nape with orange spots; head green, with bright red stripes and spots; cheek golden, the color bounded by a green band above; creamy red marks on chin and throat, bordered by green; a large jet black spot behind shoulder, with two blue ones within it, the color extending as a bar to ventrals, green, with red spots; an indigo-black spot above lateral line before caudal; dorsal light green with three stripes of creamy scarlet; caudal orange, fading behind, a greenish edge above; anal greenish with two red stripes, the basal one narrower and deeper in color; pectoral colorless; ventral flesh color.

(2) From Apia. Bright green; each scale with a dark olive spot; head green, yellow below, with coppery red streaks and spots about eye; a small black ocellus at base of pectoral, a pink crossbar behind it; a large black spot on caudal peduncle; dorsal greenish, finely covered with coppery red lines; caudal, anal, and ventral similarly barred; belly whitish; pectoral pale.

(3) From Pago Pago. Pale bluish gray, the sides of head sometimes but not always brassy; pale blue stripes before and behind eye, below eye horizontal; tip of snout with plain oblong black spot above; side of body with six blackish cross shades, the second and third widest and more or less confluent; a large blue-black spot on side before caudal; a small black ocellus at upper base of pectoral; fins plain olivaceous; a violet-blue vertical spot on each scale of body.

(4) A larger example. Head green, golden below, the marks crimson not blue; bands more reduced; second and third still plainer; spots on scales orange brown; black pectoral spot at base above, with a green, red-edged bar below it, and a red bar across axil to ventral; throat with two red cross-bands; precaudal spot large and distinct, black rose spot obscure; fins all pale reddish, the dorsal streaked with red on green ground; nape with close-set red spots.

935. Halichœres dædalma Jordan & Seale, new species. *Fataga loa.* Samoa. (Pl. XLVII, fig. 2.)

Head 3 in length; depth 3.20; eye 5.50 in head; dorsal IX, 11; anal III, 11; scales 25; snout 3.10 in head; interorbital equal to orbit.

Body elongate, compressed, the anterior profile of head evenly pointed; depth of caudal peduncle 2.20 in head; teeth in a single series in each jaw, the anterior ones projecting canines, a single posterior canine at angle of jaw; lips rather thick, with folds; angle of jaws scarcely reaching to anterior margin of eye; opercle and preopercle entire, no scales on cheek; the last spine of spinous dorsal the longest, 3 in head; the longest soft ray 2.75; pectoral 1.50 in head; ventral 1.25; base of anal 1.85 in base of dorsal, its longest ray about 3 in head; caudal slightly rounded, 1.75 in head.

In spirits the ground color is yellowish, the upper two-thirds of body with bluish coloring forming more or less distinct bands; nine short silvery white lines over back, separating the bluish bands; belly and under surface with slight tint of pale blue; four rather distinct bands of blue extending from median line of side toward base of anal fin; head with a straight blue line from angle of jaw to midway of opercle; another blue line from distal end of upper lip through lower part of orbit, dividing first back of eye, where it is deep blue, one branch curving back and down on to lower posterior margin of opercle; may or may not unite with the dark opercular spot; the other branch extending up and ending on shoulder just above opercle; another blue line from tip of snout to upper part of orbit and extending a short distance back from orbit; two blue blotches on interorbital space one on each side of nuchal region; a black dot between 1st and 2nd dorsal spines; another, much larger, between the 2nd and 3rd dorsal rays; the outer third of dorsal fin has a number of round white spots; the inner portion is similarly colored but the spots are larger and some are paired, forming short thick bands; anal fin with a blue band through the middle which may be more or less broken up into round spots posteriorly; a row of round spots at base of fin; caudal with three rows of dusky bands and some white spots with wash of dusky at tip; pectoral and ventral yellow, unmarked.

In life a specimen from Pago Pago was much mottled, shaded with pink; a black dorsal ocellus, a black opercular blotch; a large black blotch on side; a pink silvery area below eye.

A specimen from Apia, called *fatagaloa*, was green with red-brown scallops above, the markings brighter below; a blackish blue blotch on caudal peduncle; head with red stripes and green, the edgings of the red stripes bright blue; a horizontal red stripe below the eye; opercle with a dark creamy red spot at tip, golden olive before it; dorsal green and brownish red, the green in rounded blue-edged spots; a black spot on first soft rays; caudal banded green and brownish red; anal paler green and red; ventral green and red.

This species is very common about Samoa, where we obtained 48 specimens from the reef at Apia. A dozen small immature fish, collected at Pago Pago, have been referred by us to this species. The species is very close to *Halichœres pœcilus*, but the markings are different, notably those on the cheek which form a straight stripe, not a ring or horseshoe.

The type, no. 51845, U. S. National Museum, is from Apia and is 4 inches long.

936. **Halichœres pœcilus** (Lay & Bennett). New Guinea (Macleay); East Indies.

(*Halichœres harloffi* Bleeker; *Halichœres annulatus* Fowler.)

937. **Halichœres guttulatus** (Macleay). New Guinea.

Platyglossus guttulatus Macleay, Proc. Linn. Soc. N. S. W. 1883, 587.

338. **Halichœres opercularis** (Günther). Fiji; Samoa. (Pl. XLVII, fig. 3.)

This species is very close to *Halichœres pseudominiatus* of the East Indies. Comparing our specimens with some from Negros, we are inclined to think that *Halichœres opercularis* is a distinct species. The chief difference lies in the arrangement of the colored stripes on the head.

This species is very abundant about Samoa and about 170 specimens were taken.

Life colors of a specimen from Apia, light olive, with a net-work of dark brown lines above; side golden with two white vertical streaks anteriorly behind pectoral, a broad, bright, purple-pink band at vent, then golden with incursions of purple from the dark bands above; dorsal with vertical streaks of brownish red on yellow; a large and conspicuous black ocellus on front of soft dorsal; a smaller black spot on front of spinous dorsal; caudal yellowish, cross-banded with brownish red; anal similar, ventral pink; pectoral colorless; head brownish and streaked above, with a bright orange streak before and behind eye; a horizontal curved stripe below eye creamy yellow, bordered by light blue and rimmed with dark blue, this bending around forward on subopercle and cheeks; a black ocellus on opercle; about eight whitish spots along base of dorsal, one of them in axis of soft dorsal.

A young specimen from Pago Pago was whitish with scattered reddish spots and incomplete broad blackish transverse band; dorsal with conspicuous semi-ocellus; green, yellow and black-brown on anal; caudal clear; snout red; iris rose-red.

939. **Halichœres margaritaceus** (Cuvier & Valenciennes). Vanicolo.

This species, imperfectly described, is very similar to *Halichœres opercularis*, but no mention is made of ocelli on the dorsal fin.

940. **Halichœres macleayi** Jordan & Seale, new name. New Guinea.

Platyglossus margaritaceus Macleay, Proc. Linn. Soc. N. S. W. 1884, 274, Hood Bay; not of Cuvier & Valenciennes.

941. **Halichœres auritus** (Cuvier & Valenciennes). Ulea.

This species, scantily described, is an ally of *Halichœres opercularis*, but nothing is said as to ocelli on the dorsal fin.

942. **Halichœres nebulosus** (Cuvier & Valenciennes). Guam (Seale); East Indies.

943. **Halichœres gymnocephalus** (Bloch & Schneider). New Guinea (Macleay); Faté (Seale); East Indies.

Labrus gymnocephalus Bloch & Schneider, Syst. Ichth., 180, 351; fide Peters.
Julis modestus Bleeker, Verh. Bat. Gen., XXII, Labr. Cycl., 26.
Halichœres modestus Bleeker, Atlas, Labr., 126, tab. XXXV, fig. 2, East Indies.
Platyglossus modestus Günther, Cat., IV, 157, Singapore.

944. **Halichœres leparensis** (Bleeker). Guam (Seale); East Indies.

945. **Halichœres papilionaceus** (Cuvier & Valenciennes). Vanicolo.

946. **Halichœres chloropterus** (Bloch). New Guinea (Macleay); East Indies.

947. **Halichœres ornatissimus** (Garrett). Hawaii.

(*Halichœres iridescens* Jenkins.)

948. **Halichœres lao** Jenkins. Hawaii.

949. **Halichœres guttatus** (Bloch). New Guinea (Macleay).

950. **Halichœres solorensis** Bleeker. Marquesas Islands (Seale); East Indies.

951. **Halichœres melanurus** (Bleeker). New Guinea (Macleay).

PSEUDOJULIS Bleeker.

952. **Pseudojulis cerasina** Snyder. Hawaii.

CORIS Lacépède. (*Hemicoris* Bleeker.)

The genus *Hemicoris*, of Bleeker, having scales 50 to 60, differs from *Coris* only in the absence of posterior canine teeth. These are not well developed even in *Coris*, and are said to be occasionally absent. For that reason the genus probably can not be maintained.

The genus *Julis* Cuvier (not of Bleeker or Günther), having the scales 70 to 80, is better defined and is possibly worthy of retention.

953. **Coris aygula** Lacépède. Guam; Tahiti; Faté and Tubuai (Seale); Hawaii (Fowler—a doubtful record); Japan; East Indies.

954. **Coris cyanea** Macleay. New Guinea.

955. **Coris papuensis** Macleay. New Guinea.

956. **Coris variegata** (Rüppell). New Guinea (Macleay); New Hebrides; East Indies.

(Ramsay & Ogilby, Proc. Linn. Soc. N. S. W. 1886, 131.)

957. **Coris venusta** Sauvage. Hawaii.

(*Hemicoris remedius* Jenkins.)

958. **Coris multicolor** Rüppell. Aneiteum (Günther); Red Sea.

959. **Coris ballieui** Vaillant & Sauvage. Hawaii.

(*Coris schauinslandi* Steindachner.)

960. **Coris rosea** Vaillant & Sauvage. Hawaii.

(*Coris argenteostriatus* Steindachner; *Hemicoris keleipionis* Jenkins. Not *Julis rosea* Quoy & Gaimard.)

961. **Coris cingulum** (Lacépède). New Guinea (Macleay); Aneiteum (Günther); East Indies.

962. **Coris caudimacula** (Quoy & Gaimard). Rarotonga (Seale); Mauritius.

JULIS Cuvier.

963. **Julis greenovii** Bennett. Samoa; Hawaii; Manado.

This striking fish is rare about the Samoan Islands. We have three specimens from Apia. It was originally described from Hawaii, but we did not find it there. The colored plate in the report on the fishes of Hawaii is from a Samoan specimen. The coloration shown in that plate is much less bright than that in nature.

Life colors of a specimen from Apia, deep scarlet-red, each scale with an olive speck, below pure cherry-red, 5 blotches on back pure white edged with black, a black blotch on tail filled with bright blue spots; a bar on caudal black, whitish in middle; anal red with a blue edge; ventral, also pectoral, light orange-red; a row of blue spots at base of anal; dorsal clear red with a blue-black edge.

964. **Julis pulcherrima** (Günther). Hawaii; Samoa; Tahiti; Aneiteum; New Hebrides; Guam; New Guinea; East Indies.

This beautiful fish seems to be rare about Samoa, though rather common at Honolulu. We have one adult specimen from Apia, which agrees very well with Bleeker's figure.

Life colors, head coppery red with green stripes edged with violet; throat with a blackish green stripe; body reddish brown, becoming blackish behind; almost everywhere covered with small deep violet spots; crowded behind, sparse in front, none on head; dorsal bright orange, brown at base with violet-blue spots; soft dorsal cherry red; caudal plain golden yellow running on to orange on edges; anal drab orange-brown with violet markings; pectoral orange, the axil blue-black, edged with grass-green; ventral olive, with a wide maroon stripe, then a violet edge.

965. **Julis gaimardi** Quoy & Gaimard. Hawaii; East Indies?

This species is rather common about Hawaii. It is possible that the East Indian specimens called *Coris gaimardi* belong to some other species.

966. **Julis cuvieri** Bennett. New Hebrides; Ile de France.

967. **Julis flavovittata** Bennett. Hawaii; Laysan.

968. **Julis eydouxi** (Cuvier & Valenciennes). Hawaii.

969. **Julis lepomis** Jenkins. Hawaii.

HOLOGYMNOSUS Lacépède.

970. **Hologymnosus longipes** (Günther). Aneiteum.

971. **Hologymnosus elongatus** (Günther). Aneiteum.

972. **Hologymnosus semidiscus** (Lacépède). New Guinea (Macleay); Tahiti and Rarotonga (Seale); East Indies.

(*Labrus annulatus* Lacépède.)

CHEILIO Lacépède.

This genus, close to *Thalassoma*, differs in the elongate body and smaller scales. There seems to be but one species, widely distributed and varying considerably in shade of color.

973. **Cheilio inermis** (Forskål). *Masamie; Moai.* Hawaii; Samoa; Guam; Vanicolo; Tahiti; Aneiteum; New Guinea; East Indies.

This common and widely spread species is rather scarce at Samoa, though very abundant at Honolulu. We have one specimen from Apia.

THALASSOMA Swainson. (*Julis* Günther, not of Cuvier.) *Sugale* (choice).

This genus is distinguished by the presence of 8 dorsal spines, large scales, and no posterior canine teeth. The species are all beautifully colored.

974. **Thalassoma duperreyi** (Quoy & Gaimard). Hawaii; Johnston I.; Laysan; Mangareva, Gambier Is. (Seale); Acapulco (as *Thalassoma steindachneri* Jordan & Evermann).

(*Thalassoma clepsydralis* Smith & Swain.)

975. Thalassoma ballieui (Vaillant & Sauvage). Hawaii; Johnston I.

(*Julis obscurus* Günther; *Thalassoma verticalis* Smith & Swain.)

976. Thalassoma lunare (Linnæus). New Guinea (Macleay); East Indies.

Apparently all the East Indian references to *lunaris* belong to *T. lunare* and the Polynesian references to *T. lutescens*. The species from the Riukiu Islands figured by Bloch as *Labrus viridis*, by Bennett and by Brevoort as *Julis lutescens* and described in detail by Jordan & Snyder (Proc. U. S. Nat. Mus., XXIV), as *T. lutescens*, is the true *lutescens*, being different from *T. lunare*.

977. Thalassoma guntheri (Bleeker). Samoa; Fanning I. (Streets, Bull. U. S. Nat. Mus., VII, 1877, 83); New Guinea (Macleay); East Indies.

We have one fine specimen from Apia, apparently referrable to this species. Life colors, bright olive green, much mottled and varied; a bright crimson lateral stripe; another above it, broader, duller, more diffuse, and connected with the first by cross streaks; two oblique crimson stripes from pectoral across belly anteriorly, separated by blue-green; belly livid violet gray; head dark; a red area on preorbital; a deep blue stripe through eye from snout to opercle; a curved blue stripe bounding dark bluish brown of lower part of head; lower jaw orange with a blue stripe; dorsal bluish at base, then crimson in a broad band, then bluish, then broadly edged with green; caudal very pale reddish, this color surrounded by whitish and blue, the upper and lower rays and lobes crimson, the upper a continuation of the dorsal stripe, the lower line extending forward on caudal peduncle; anal pale livid grayish; pectoral colorless, the axil red and green, the outer half jet black; ventral colorless grayish.

978. Thalassoma lutescens (Solander). Hawaii; Tahiti; Fanning Is. (Streets); Marcus I. (Bryan); Riukiu Is.

979. Thalassoma purpureum (Forskål). Hawaii; Samoa; Tahiti; Guam; Caroline Is.; Aneiteum; Laysan; Thornton I.; East Indies.

Scarus purpureus Forskål, Descr. Anim., 27, 1775, **Red Sea**; not *Julis purpurea* Rüppell, and of Günther, which is *Thalassoma ruppelli* (Klunzinger).
Thalassoma purpureum Seale, Bishop Museum, 1901, 91, Guam.
Julis quadricolor Lesson, Voy. Coquille, II, 139, pl. 35, fig. 1, 1826–1830, **Tahiti**. Cuvier & Valenciennes, Hist. Nat. Poiss., XIII, 443, 1839, Tahiti. Bleeker, Atlas, Labr., 93, 1862, not the plate which is *Thalassoma fuscum*.
Thalassoma quadricolor, Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (1903), 462, Hawaii.
Scarus semicæruleus Rüppell, Neue Wirbelthiere 10, pl. 3, fig. 1, 1835, **Red Sea**.
Scarus georgii Bennett, Fish. Ceylon, pl. 24, **Ceylon**.
Julis erythrogaster Cuvier & Valenciennes, Hist. Nat. Poiss., XIII, 447, 1839; may be *Thalassoma cyanogaster*.
Scarus quinquevittatus Richardson, Voy. Blossom, 66, pl. 19, fig. 3.
Julis ruppelli Steindachner, Denks. Ak. Wiss. Wien 1900, 506, **Laysan**; not of Klunzinger.
Thalassoma immanis Fowler, Proc. Ac. Nat. Sci. Phila. 1899, 488, pl. 18, fig. 2, **Caroline Is.**
Thalassoma berndti (misprinted *berendti*) Seale, Bishop Museum 1901, 115, fig. 7, **Honolulu**.

This species is confused by Günther with *Thalassoma fuscum* under the name of *Julis trilobata*. *T. purpureum* may be known by the variegated head, with three broad scarlet wedges radiating from the eye, and by the presence of three red stripes on a blue-green ground. The fins are colored differently from those of *T. cyanogaster*. (For color notes see Fishes of Hawaii.) In *T. fuscum* the head is plain red, and there are two rows of quadrate blotches, compared by Lacépède to Chinese characters, on each side. These are blue on a red background.

T. purpureum is widely diffused in the South Seas. We have one fine specimen from Apia, and several from Honolulu.

980. Thalassoma cyanogaster (Cuvier & Valenciennes). Tahiti; Samoa.

Julis cyanogaster Cuvier & Valenciennes, Hist. Nat. Poiss., XIII, 444, 1839, **Tahiti**; on a drawing of Solander.

Of this species, well distinguished from *Thalassoma purpureum* by its coloration, we have one fine example from Apia and one from Pago Pago.

Life colors of the specimen from Apia, bright grass-green, yellowish below with three longitudinal stripes of clear coppery red, cross-hatched; head green with many red stripes and spots; two green stripes forward from eye; a scarlet irregular streak downward and backward across preopercle and subopercle, with numerous irregular red spots and blotches behind it and above it; dorsal green at base, then orange red, then a narrower grass green stripe, then a red one, the soft rays each tipped with grayish blue; caudal with rays pale red, the membranes bright green, the middle rays tipped with yellow, the outer with blue; anal striped, green, bright red, blue, narrow green, lighter red, finally blue; ventral greenish at base, reddish behind; pectoral dusky above without distinct spot, a green bar toward base, a scarlet one below it, then a large green patch behind opercle, with a wavy red stripe surrounding the green, pectoral black at tip; livid blue shades at throat.

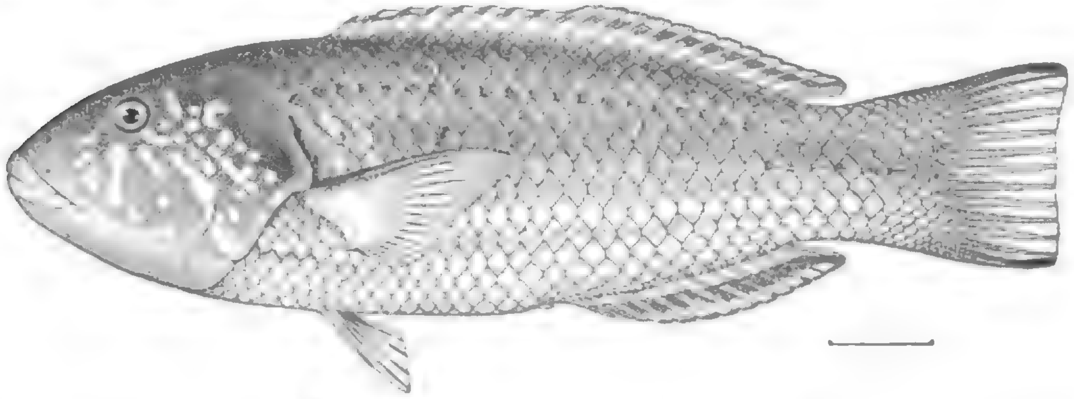


FIG. 53.—*Thalassoma cyanogaster* (Cuvier & Valenciennes).

981. Thalassoma fuscum (Lacépède). Hawaii; Samoa; Laysan; New Hanover; Aneiteum; Tubuai; Rarotonga and Makatea (Seale); East Indies.

Labrus fuscus Lacépède, Hist. Nat. Pois., III, 437, 1802, **Ile de France.**

Labrus trilobatus Lacépède, Hist. Nat. Pois., III, 454, 526, 1802, **Bourbon, Madagascar.**

Julis trilobatus, Cuvier & Valenciennes, Hist. Nat. Pois., XIII, 437, 1839, Ile de France. Günther, Cat., IV, 187, var. A. South Africa, Mauritius, Aneitum. Peters, Berl. Mon. 1876, 843, New Hanover.

Julis formosus Cuvier & Valenciennes, op. cit., XIII, 439, 1839, **Ile de France.**

Julis æruginosus Cuvier & Valenciennes, op. cit., 441, 1839, **Ile de France.**

Julis quadricolor Bleeker, Atlas, Labr., 93, tab. XXXIV, fig. 3, Java; not of Bennett.

Julis purpureus Steindachner, Denks. Ak. Wiss. Wien 1900, 506, **Honolulu, Laysan.**

Thalassoma purpureum, Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (1903), 462, Hawaii; not of Forskål.

This species, known by its green, jews-harp markings on a red ground, compared by Lacépède to Chinese script, is occasionally taken in the South Seas. We have two specimens from Apia and several from Hawaii.

Life colors of a specimen from Apia, deep red brick color, paler below, the squares deep-bluish green; head coppery olive; first dorsal creamy scarlet, the base green, the edge sky-blue; soft dorsal similar with a red intermarginal band; caudal with rays sky-blue, the membrane bronze-orange; anal orange on basal half, the rest sky-blue, a dark line separating a greenish shade at base; ventrals blue, green at tip; pectoral dusky, darker above with diffuse blackish blotch at tip; axil deep blue, a blue spot rather faint at upper angle of gill opening.

982. Thalassoma punctatum Seale. Guam; Rarotonga (Seale).

Julis punctata Seale, Bishop Museum 1901, 91, **Guam.**

This species seems to be close to *Thalassoma fuscum*, but it has a black ocellus on the back of the tail.

983. Thalassoma umbrostigma (Rüppell). Hawaii; Samoa; Laysan; Makatea (Seale); East Indies.

This is an abundant species at Honolulu, but seems to be scarce at Samoa. We have one adult specimen from Apia, and 6 young ones from Pago Pago. Life colors of four young specimens from the latter place were as follows:

(1) Green, bluish white below; three longitudinal bands of dark brown and rose pink; a brick red spot at tail end of each of these bands; anal bluish white with rose suffusion; caudal clear with rose suffusion; dorsal with rose-pink shading.

(2) Yellow-green above, blue green below; two longitudinal series of brick-red spots with blackish centers.

(3) Bright green; 3 lengthwise series of quadrate spots, the median largest and joined by a reddish brown shade; a spot behind eye, the median band extending through eye; upper band also

distinct, forming 8 spots, the last a speck at upper base of caudal, above sixth on body in the second band; dorsal green with a black spot behind first spine and three in a triangle at first soft ray; fins otherwise all pale green; no axil spot and no dark shade on pectoral.

(4) Bluish below, green on sides and dorsum, with pronounced rose-pink blotches and bars, darker above; pectoral with rose-pink axil; greenish yellow outside at base of pectoral and a small greenish yellow blotch on pectoral itself near base; dorsal green with dark rose-pink median line; anal with rose-pink line along base; caudal blue green with narrow pink blotches and greenish yellow margin.

984. Thalassoma genivittatum (Cuvier & Valenciennes). Marcus Island (Bryan & Herre, Bishop Museum, 1903, II, 131); East Indies.

985. Thalassoma dorsale (Quoy & Gaimard). *Sugale sei; Sugale pulepule; Sugale fa'a'ele'ele.* Samoa; Fiji; Aneiteum; New Ireland; New Guinea; Marcus I.; Shortland I. (Seale); East Indies.

This species is common in the East Indies, Indian Ocean, and South Seas. We have 12 specimens from Pago Pago, and 16 from Apia.

Life colors of specimens called *sugale sei*, from Apia, dark green; 5 indigo blue black crossbars; a bright red lateral streak posteriorly, a fainter one above it, blue below this; 5 broad greenish coppery red bands radiating from eye, the broader anteriorly blue; a black spot before and across base of pectoral; a blue-black spot on base of tail in larger one; chin and lower part of head dark blue (males with a large black green-edged spot above pectoral); sides mottled with red; dorsal blue black; the soft dorsal broadly golden at tip, a bluish streak below the golden; a pale streak across base of spinous dorsal and pale tips; caudal translucent yellowish green, a red streak on each lobe, and a light green edge above and below; anal pale yellow with a black spot anteriorly; ventrals yellowish; pectoral yellowish; a deep blue-black stripe the whole length of dorsal, pale below, yellowish above.

986. Thalassoma schwanefeldi (Bleeker). Tubuai; Austral I. (Seale); East Indies.

987. Thalassoma janseni (Bleeker). New Guinea (Macleay); Aneiteum (Günther); East Indies.

988. Thalassoma aneitense Günther. Hawaii; Aneiteum; Guam; Nukahiva (Seale).

989. Thalassoma mertensi (Cuvier & Valenciennes). Ulea.

This species, very imperfectly described from a drawing, we do not recognize. It may be the young of *Thalassoma lunare.*

GOMPHOSUS Lacépède.

990. Gomphosus varius (Lacépède). Hawaii; Samoa; Guam; Fanning Is. (Streets); New Guinea (Macleay); East Indies.

This species is rather common about the Hawaiian Islands, as also about Samoa. We have 5 examples from Apia.

We are not altogether certain that the Hawaiian species, *Gomphosus pectoralis*, is fully identical with the East Indian *Gomphosus varius*, but the evidence points in that direction. Apparently *Gomphosus undulatus* and *Gomphosus pacificus* are color variations of this species.

991. Gomphosus undulatus Streets. Fanning Is.

Gomphosus undulatus Streets, Bull. U. S. Nat. Mus., VII, 85, 1877, **Fanning Is.**

This species, doubtfully separable from *Gomphosus varius*, is unknown to us.

992. Gomphosus pacificus Seale. Guam.

Gomphosus pacificus Seale, Bishop Museum 1901, 94, **Guam.**

This species is probably a color variant of *Gomphosus varius.*

993. Gomphosus tricolor Quoy & Gaimard. *Sugale.* Hawaii; Samoa; Tahiti; Caroline Is.; New Guinea (Macleay); Rarotonga; Makatea and Mangareva (Seale); East Indies.

This singular and beautifully colored fish is common about the Hawaiian Islands and occurs throughout the South Seas. We have two specimens from Apia and one from Pago Pago.

Life colors of a specimen from Apia called *sugale*, deep greenish black, indigo blue on head, each scale of body with a violet bar and an olive wash; a bright yellowish green bar above axil, which is black; dorsal and anal light clear green, bluish at tip; caudal blue black on edges, pale behind, mesially light vitriol blue; pectoral with a yellowish green crossbar at base, then dusky green, black on posterior edge with a vertical median band of vivid clear blue; ventral blue black. Another was, in life, green, rather than blue; dorsal and anal yellowish green.

Life colors of a specimen from Pago Pago, dorsal blue-green growing yellowish green at margin; anal and caudal similar; body purplish green with dark pinkish maroon and light olivaceous scale markings.

994. Gomphosus sandwichensis Günther. Hawaii.

CIRRHILABRUS Schlegel.

995. Cirrhilabrus jordani Snyder. Hawaii.

996. Cirrhilabrus solorensis Bleeker. New Guinea (Macleay).

CHEILINUS Lacépède.

997. Cheilinus trilobatus Lacépède. *Sugale matamumu; Lalafi.* Samoa; Tahiti; New Guinea; Ladrones; Guam; Fiji; New Hebrides; Kingsmill I.; Howland I.; Ponape; Futuna; Hawaii (Quoy & Gaimard—as *Cheilinus sinuosus*, *Cheilinus polygrammus* Cuvier & Valenciennes, and *Cheilinus maculosus* Cuvier & Valenciennes); East Indies.

This wide-spread species is very abundant about Samoa. We have 26 specimens from Apia, and 9 from Pago Pago. Quoy & Gaimard record it from Hawaii, but no subsequent collector has seen it there. Life colors were noted in various specimens as follows:

(1) From Apia. Olive-gray; a series of greenish blue cross-streaks, very numerous and well-defined; pale cherry-red cross-shades between them; head with radiating streaks and spots of crimson; chin dull, blunt; dorsal light olive with cherry-red edge and intramarginal streak; soft rays mostly colorless; a little dusky spot at base; caudal dusky, edged all around with pale, the tip and edge mostly red; anal olive with green rays, and two red marginal; ventral with blue rays, an olive blotch, and a pink edge; pectoral yellow olive; dark olive at base.

(2) From Apia. Blackish green; a bright orange-red vertical stripe on each scale, these faint or obsolete posteriorly; head with many bright scarlet stripes and dashes; spinous dorsal olive-green with two scarlet stripes and about four diffuse cross-shades; soft dorsal clear pinkish orange, the rays yellow; no bars or spots; anal dark olive and pinkish orange in streaks, paler behind; no spots; caudal dark olive-green washed with scarlet at tip, yellow-olive between; ventrals pink orange, the rays dark olive-green; pectoral light yellowish olive; throat livid dusky blue; breast coppery green; caudal rounded.

(3) From Apia. Marbled olive-green with four diffuse blackish bars; each scale with a brown vertical streak; head with curved and vertical streaks and bars; spinous dorsal mottled orange, green and brown, soft translucent pink; anal similar, its edge broadly translucent pink; pectoral fleshy red; ventral olive and reddish barred.

(4) From Pago Pago. Dark olive-greenish with pinkish and greenish vertical linear scale spots; head richer dark green with pink linear and spotty markings; pectorals thin, yellowish; ventral with green rays and pink interspaces; anal with pink submarginal line and anterior half with second pink line; general color greenish and bluish; caudal dark bluish; green at base, paler at tip; small round jet-black spot before base of caudal.

998. Cheilinus hexagonatus Günther. Hawaii; Johnston I.

(*Cheilinus zonurus* Jenkins.)

999. Cheilinus pulchellus Sauvage. Fiji.

Cheilinus pulchellus Sauvage, Bull. Sci. Philom., 1880, 14 (reprint), Fiji.

1000. Cheilinus fasciatus (Bloch). *Lalafi pulepule.* Samoa; Guam; Solomon I.; Palau I.; New Guinea; Kingsmill I.; Vavau; Ponape; Faté; Shortland I. and Rarotonga (Seale); East Indies.

This species has a wide range extending from the Red Sea to the islands of the Pacific. It is very common about Samoa; we have 50 specimens from Pago Pago and 7 from Apia. Life colors were noted in various specimens as follows:

(1) From Pago Pago. Below eye thin brick-red extending, somewhat smoky, over dorsum just in front of dorsal fin; breast region vermilion; upper head very smoky greenish with short reddish lines

radiating from eye; under jaw pale smoky; body grayish black with irregular pale narrow cross-bars; small black circular spots on sides, red ones ventrally; caudal black and whitish banded with scarlet; ocellar spots coalescing in vertical series in outer (submarginal) white band; dorsal with two narrow crimson lines—crimson pink spots—markings toward posterior end; pectoral thin brick-red; ventral crimson with blackish blotch.

(2) From Apia. Olive; body with 6 dark bars, irregular and broader than interspaces; posterior half of head and first band and breast clear cinnamon-brown, the head anteriorly olive; iris scarlet; scarlet and green dashes radiating from eye; lower jaw olive-brown; 2 darker shades across nape; some scales on body darker than others; dorsal gray, red-edged; soft dorsal brown, the last rays transparent orange; a broad pale yellow bar across base of caudal, the fin with 2 black bars and finely crossed by orange lines; caudal truncate; anal barred at base like body, the edge mottled scarlet, the last rays translucent, tinged green and orange; ventral bright orange red washed with black; pectoral brownish, scarlet at base; lower part of sides with some round brown spots.

(3) From Apia. Greenish above, reddish below, with dark shade on each scale; 5 whitish olive cross-bands, much narrower than interspaces, the one at base of caudal broadest; snout paler olive; dorsal and anal colored like body, not dotted; caudal with 2 dark cross-bands; last rays of dorsal and anal pinkish translucent; sides of breast and belly with dark brown spots. Caudal truncate.

(4) Specimen called *lalafi pulepule*. Apparently much in common with the preceding, but with additional colors. Whole shoulder region from base of dorsal across opercle and base of pectoral to breast and including ventrals deep ferrugineous red, the ventrals very deep red; dorsal colored like body, but with scarlet edge and two rows of scarlet spots on anterior soft rays; anal spotted with scarlet, yellowish translucent behind, as is soft dorsal; some scarlet spots on yellowish band of anal, between two dark spots; scarlet streaks radiating from eye; dark greenish olive, with five narrow pale olive cross bands; the widest at base of caudal; caudal with two dark bands.

1001. Cheilinus digrammus (Lacépède). *Sugale; Lalafi.* New Guinea; Louisiades; Fiji; Samoa; Palau Is.; Shortland I. (Seale); East Indies.

We have eight specimens of this species from the coral reef at Pago Pago, where it is common. Life colors of one specimen, greenish gray with weak salmon-brown scale-blotches; weak salmon diffusion below; pink copper lines on upper head; on lower head purple-brown lines; lips olive-green, also upper head; dorsal with pinkish margins; anal with almost crimson splashes; ventral with crimson coloration at base; pectoral unmarked, thin saffron rays; caudal with blue-green rays, paling and faintly reddish yellow at tips.

1002. Cheilinus undulatus Rüppell. Samoa; Tahiti; Fanning Is.; New Guinea; Vavau; Paumotu Is.; Caroline Is.; Palau Is.: Oualan (as *Cheilinus festivas*); Tonga (as *Cheilinus godeffroyi* Günther, Proc. Zool. Soc. London 1871, 666, pl. 66, young).

This handsome and widely distributed fish was found only at Pago Pago, where we obtained two large specimens. Life colors of one of these, olive-gray, a black area on each scale, these becoming brownish reticulations on breast; streaks before and behind eye black; orange streaks on head below eye, bluish streaks above. Vertical fins all checkered with black bars; tip of caudal bright pale yellow; ventral pale gray.

The other specimen was livid white under head, with salmon-yellow spots and curving linear blotches; salmon-yellow spots on lips; head above light umber with slaty blue-gray lines; sides greenish olive (grayish green?), with vertical blackish brown spots tapering to point above and below; region below pectorals light-yellow greenish with fine purplish red lines; pectoral clear, with greenish yellow tinge at base; ventral thin greenish; dorsal coarsely mottled brownish, with greenish yellowish white spots; caudal similar with yellow margin; from eye two brown-black lines running forward and back with small spot between hinder two near eye.

1003. Cheilinus unifasciatus Streets. Fanning Is.

Cheilinus unifasciatus Streets, Bull. U. S. Nat. Mus., VII, 1877, 82, **Fanning Is.**

This species is unknown to us. Dr. Streets regards it as very close to *Cheilinus rhodochrous* of Günther.

1004. Cheilinus ceramensis Bleeker. Aneiteum; East Indies.

1005. **Cheilinus nigropinnatus** Seale. Guam.

Cheilinus nigropinnatus Seale, Bishop Museum 1901, 86, Guam.

1006. **Cheilinus oxycephalus** Bleeker. New Guinea (Macleay).

1007. **Cheilinus oxyrhynchus** Bleeker. Palau Is. (Günther); East Indies.

1008. **Cheilinus kittlitzi** Cuvier & Valenciennes. Ulea.

Cheilinus kittlitzi Cuvier & Valenciennes, Hist. Nat. Poiss., XIV, 105, 1839, Ulea; on a drawing.
Cheilinus sanguineus Cuvier & Valenciennes, l. c., Ulea; on a drawing.

1009. **Cheilinus roseus** Cuvier & Valenciennes. Ulea.

Cheilinus roseus Cuvier & Valenciennes, l. c., Ulea; on a drawing by Mertens.

1010. **Cheilinus bimaculatus** Cuvier & Valenciennes. Hawaii.

THALLIURUS Swainson.

Dorsal spines 10, otherwise essentially as in *Cheilinus*.

1011. **Thalliurus chlorurus** (Bloch). *Sugale gasufi.* Samoa; Yap; Ponape; Tahiti; Tonga; Fiji; Palau Is.; New Hebrides; Paumotu Is.; East Indies.

This common and widely distributed species is abundant at Samoa. We have 4 examples from Pago Pago and 25 from Apia. Life colors were noted in various specimens as follows:

(1) From Pago Pago. Dark olive, scales anteriorly and below each with a round blackish-brown spot; those posteriorly and on back each with a median grayish shade, each forming streaks along rows of scales; a round dusky blotch behind tip of pectoral; another on same line behind it, with traces of two others, the last at base of caudal; dorsal mottled like back, the edge scarlet; soft dorsal translucent orange, deep scarlet at base, with a row of white dots; caudal dark orange, with rows of white dots, and angular white vermiculations at base; anal dark brown, paler behind, with many rows of white dots; ventral dark orange, profusely dotted with white; head with scarlet streaks and dashes; jaws barred with brown.

(2) From Apia. Mottled brown, very dark, not pale below; some dark spots on scales deep brown; head with scarlet spots and dashes, its lower parts blackish green; pale parts of dorsal, anal, and caudal cherry-red with spots of whitish green or grayish blue; ventral very dark-brown red with gray spots, small; pectoral plain reddish.

(3) From Apia. Dark olive, with blackish brown streaks on head; blackish brown spots on scales anteriorly and grayish spots on back and posterior parts; fins much mottled; anal and ventral with small round whitish dots; dorsal edged with dull orange, the posterior rays translucent, tinged with orange-red at base; caudal much mottled, olivaceous washed with orange-red at tip; anal dark olive, dull orange at tip with many white spots; ventral similar, darker; pectoral colorless, yellow at base; caudal truncate.

(4) From Pago Pago. Complexly and irregularly mottled with greenish, brownish, and reddish indications, most marked on dorsal, of three transverse bars; eye with green iris and red circumorbital ring; under side in front of ventrals with bluish-white spots and cross-bars. Spines of dorsal blue green; at base of tail a small but distinct ocellus, with sky-blue pupil, then narrow black line, then yellow going off unevenly into reddish; caudal greenish-blue web, whitish spines; small red cross spots on web and longitudinal spots on rays.

(5) From Apia. Olive with many darker spots and mottlings, a vague row of 4 small blackish spots between pectoral and caudal, the first largest; head with brown streaks; dorsal yellowish and brownish and olive, the last rays clear; caudal with 4 or 5 dark-brown bars; anal and ventral like spinous dorsal, many spots but none stellate.

(6) From Apia. Everywhere excessively mottled, olive, black, and reddish; radiating dark-brown streaks about eye; last soft rays of dorsal translucent pink.

PSEUDOCHEILINUS Bleeker.

This genus is well defined, as shown by Professor Snyder, by the peculiar structure of its partly divided cornea. The species are small and the deep-blue pigment in the fins persists in alcohol.

1012. **Pseudocheilinus octotænia** Jenkins. Hawaii.

1013. Psuedocheilinus hexatænia Bleeker. *I'a tusitusi.* Samoa; Tahiti; Phoenix I.; East Indies. (Pl. XLIV, fig. 2.)

Cheilinus psittaculus Steindachner, Sitz. Ak. Wiss. Wien, LIV, 1866, 376, fig. 1, **Samoa.**

We have 18 examples of this pretty little fish taken at Apia.

Life colors of a specimen called *i'a tusitusi*, deep purplish blue with six orange stripes which fade on tail; tail rather abruptly grass-green, paler and yellowish behind; black at upper part of peduncle; head rosy, bluish above; chin with two black dots; breast blue; ventrals deep blue; anal purplish, anteriorly deep blue; dorsal orange anteriorly, becoming brownish behind; pectoral colorless; a black dot behind dorsal.

1014. Pseudocheilinus evanidus Jordan & Evermann. Hawaii.

NOVACULICHTHYS Bleeker.

1015. Novaculichthys woodi Jenkins. Hawaii.

1016. Novaculichthys tæniurus (Lacépède). *Molemole.* Hawaii; Samoa; Vanicolo; New Guinea; East Indies.

This species varies considerably with age. Our smallest specimens have nine black streaks radiating from the eye. As the individual grows older these are reduced to four, two upward and backward and two downward and backward. Still later, only those running downward and backward remain. These finally also disappear leaving the head in the adult quite plain. The other markings, the cream-colored band at base of caudal, the black bar across base of pectoral, the black spot on front of spinous dorsal, and the cross streaks on dorsal and anal change but little with age. In the young the first two dorsal spines are much elevated, as in *Novaculichthys kallosomus*, which differs mainly in the brighter coloration, with white markings on head and body.

Very common in the crevices of the reefs about Samoa, as also about Hawaii. We have one specimen from Pago Pago and 13 from Apia.

Life colors of an Apia specimen, olive-slate, with yellow olive shading on the scales; axil black; a golden spot on first pectoral ray at base; dorsal pale olive, with inky blotch on first rays, the fin obliquely barred with grayish; caudal dusky, a grayish bar across base; pectoral, anal, and ventral olive gray.

Other specimens from Apia, male and female, the former with banded head, were light brown; seven cross bands of dark brown; dorsal and pectoral shaded with dull orange; soft dorsal, anal, and caudal paler, shaded with yellowish; ventral dusky, dull orange washed, with white spots toward tip; a pure white spot in axil; head pale-orange washed below.

1017. Novaculichthys macrolepidotus (Bloch). New Guinea; Waigiu; East Indies.

1018. Novaculichthys kallosomus Bleeker. Hawaii; Samoa; East Indies.

We have one small specimen of this handsome East Indian fish, taken at Pago Pago. Two others, larger in size, were obtained by Snyder and Berndt at Honolulu. All are bright green in life.

Life color of a specimen from Pago Pago, brilliant grass-green with pencil-like streaks of black and bands of dark olive, these bands becoming bronze olive on the fins, markings on body of creamy white, those above greenish white; fins greenish gray, except for markings; ventral dark green.

A colored drawing made in Pago Pago from this specimen is published in Jordan & Evermann's report on the Fishes of Hawaii.

HEMIPTERONOTUS Lacépède.

1019. Hemipteronotus pentadactylus (Linnæus). New Guinea (Macleay); East Indies.

1020. Hemipteronotus umbrilatus Jenkins. Hawaii.

1021. Hemipteronotus copei Fowler. Hawaii.

Hemipteronotus copei Fowler, Proc. Ac. Nat. Sci. Phila. 1900, 508, **Hawaii.**

1022. Hemipteronotus baldwini Jordan & Evermann. Hawaii.

(*Hemipteronotus jenkinsi* Snyder, young female.)

XYRICHTHYS Cuvier.

1023. **Xyrichthys niveilatus** Jordan & Evermann. Hawaii.

INIISTIUS Gill.

1024. **Iniistius pavoninus** (Cuvier & Valenciennes). Hawaii.

1025. **Iniistius aneitensis** (Günther). Aneiteum.

1026. **Iniistius carneoflavus** (Peters). Dana Island.

Xyrichthys carneoflava Peters, Berl. Mon. 1876, 843, **Dana I.**

We have not seen this species, and we do not find Dana Island on any map. There is a Dana peak in Fiji, and part of the collection described (H. M. S. *Gazelle*) by Peters, came from Fiji. Most of it was from the New Hebrides.

1027. **Iniistius niger** (Steindachner). Hawaii.

CYMOLUTES Günther.

1028. **Cymolutes leclusei** (Quoy & Gaimard). Hawaii.

Family SCARICHTHYIDÆ.

SCARICHTHYS Bleeker.

1029. **Scarichthys auritus** (Kuhl & Van Hasselt). New Guinea (Macleay); Aneiteum (Günther); Rarotonga (Seale); East Indies.

1030. **Scarichthys cæruleopunctatus** (Rüppell). New Guinea (Macleay); Rarotonga (Seale); East Indies.

Depth 3.50 in length; eye 3.75 in head, 1 in preorbital portion of head, and 1 in interorbital space; dorsal x, 10; anal III, 9; scales of lateral line 24.

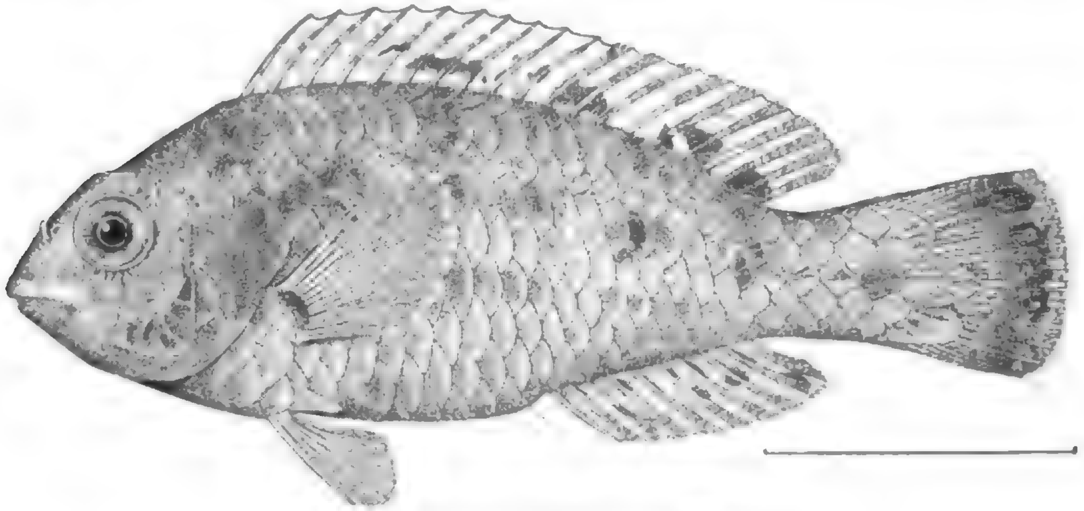


FIG. 54.—*Scarichthys cæruleopunctatus* (Rüppell).

Body oblong, compressed; lateral line interrupted, the tubules two-branched; teeth and nostrils generic; profile of head slightly different from other species of *Scarichthys*, being slightly concave above the posterior margin of the eye, and the snout with a slope slightly greater than 45°; caudal peduncle 2.30 in head; the tubules on orbitals and preopercle quite prominent; base of anal fin 2.75 in base of dorsal; length of pectoral 1.40 in head; ventral 2.

Color in spirits, dull coppery green without white dots; about five zones of darker greenish on the body, the first above base of pectoral and over shoulder, the second below the seventh and eighth dorsal spines, the third below the first to third dorsal rays, the fourth below the fifth to seventh dorsal rays, and the fifth below the axil of the dorsal; a dark blotch on base of pectoral, and another in the posterior axil of the dorsal, this dark spot occupying the base of the last four dorsal rays; the dark zones of color on the body, with the exception of the anterior one, invade the basal half ot the dorsal fin; pectoral white, without marks; ventral with indistinct darker markings; anal with five bands of dusky; caudal greenish, the tip white, and a white cross-band near the tip. Related to *S. auritus*, but the markings different.

SCARIDEA Jenkins.

1031. **Scaridea balia** Jenkins. Hawaii.

1032. **Scaridea zonarcha** Jenkins. Hawaii.

1033. **Scaridea aerosa** Jordan & Snyder. Hawaii.

CALOTOMUS Gilbert.

1034. **Calotomus irradians** Jenkins. Hawaii.

1035. **Calotomus sandwichensis** (Cuvier & Valenciennes). Hawaii.

1036. **Calotomus moluccensis** (Cuvier & Valenciennes). New Guinea (Macleay); Aneiteum; East Indies.

1037. **Calotomus waigiensis** (Quoy & Gaimard). New Guinea; Waigiu; East Indies.

Scarus vaigiensis, Quoy & Gaimard, Voy. Uranie, 288, 1824, **Waigiu.**
Scarus spinidens, Quoy & Gaimard, Voy. Uranie, 289, 1824, **Waigiu**, same type. Bleeker, Atlas, Scar., 13, tab. II, fig. 3, Amboina.
Callyodon spinidens, Günther, Cat., IV, 215, **Waigiu.**
Callyodon waigiensis, Cuvier & Valenciennes, Hist. Nat. Poiss., XIV, 296, 1839, **Waigiu.**
Callyodon hypselosoma, Bleeker, Amboina, VI, 425, **Amboina.**

1038. **Calotomus snyderi** Jenkins. Hawaii.

1039. **Calotomus cyclurus** Jenkins. Hawaii.

1040. **Calotomus carolinus** (Cuvier & Valenciennes). Caroline Is.

1041. **Calotomus brachysomus** (Bleeker). New Guinea (Macleay); East Indies.

CALLYODON Gronow (1763).

(*Scarus* Forskål, 1775; not of Gronow, 1763.)

We regret that the exigencies of the law of priority require the suppression of the time-honored name of *Scarus;* it was first used in 1763, for a species of *Labrus.*

ANALYSIS OF POLYNESIAN SPECIES OF CALLYODON.

a. CALLYODON. Jaws whitish or rosy.
  b. Species with the coloration in life chiefly dark red or brown, sometimes golden or clouded, never largely deep blue or green.
    c. Lip narrow, not covering more than half of upper jaw.
      d. Scales on cheek in two rows.
        e. Color blackish-red; caudal fin largely scarlet .... *pyrrhurus*
        ee. Color not as above.
          f. Sides with pale spots, more or less regularly arranged; young with lengthwise pale streak .... *bennetti*
          ff. Olive; scales with darker centers; fins black .... *platodon*
          fff. Dull red, brighter below, almost unmarked .... *miniatus, goldiei*
          ffff Leaden gray, unmarked .... *lenborus*
          fffff. Color brownish yellow .... *labiosus*
      dd. Scales on cheek in three rows; dark red-brown, each scale on side with three dark streaks .... *ruberrimus*
    cc. Lip broad, covering more than half of upper jaw.
        g. Scales on cheek in two rows.
          h. Color dark red-brown, nearly uniform.
            i. Side of tail with a dusky shade .... *purpureus*

ii. Back greenish .... *filholi*
iii. Dorsal reddish brown, edged with purplish black .... *erythrodon*
iiii. Dorsal rosy, edged with black .... *moensi*
iiiii. Caudal lunate, not edged behind with gray .... *brunneus*
iiiiii. Caudal lunate, dusky, edged behind with gray .... *erythaeus*
iiiiiii. Caudal rounded, paler at base; body deep .... *ahula*
hh. Color greenish, with five brown cross-bars .... *mutabilis*
gg. Scales on cheek in three rows.
j. General color dark red or dark brown, without cross shades of blackish or golden (caudal tipped with gray); *lacerta* (belly with pale streaks); *lepidus; paluca; upolensis* .... *dubius*
jj. General color violet, posteriorly chiefly yellow .... *macrocheilus*
jjj. General color olivaceous, the border of each scale darker .... *balinensis*
jjjj. General color olivaceous; a golden wash or oblique cross-band behind pectoral .... *oviceps*
jjjjj. General color golden brown; the back with five dark cross-bands .... *zonularis*
ccc. Lips and scales on cheek undescribed.
k. Color mostly red .... *roseiceps, cruentatus*
kk. Color largely varied .... *ocellatus*
bb. Species largely deep blue or deep green, the color scarcely fading in spirits; head usually more or less variegated; the fins often with red, and usually edged with blue.
l. Lip narrow, not covering more than half of upper jaw.
m. Cheek with two rows of scales.
n. Forehead with variegated markings .... *perspicillatus, brighami*
nn. Forehead plain or with a narrow cross-streak .... *quoyi, lupus, jonesi*
mm. Cheek with three rows of scales .... *papuensis, moresbyensis*
ll. Lip broad, covering more than half of upper jaw.
o. Scales on cheek in two rows .... *gilberti, bataviensis, abacurus, formosus*
oo. Scales on cheek in three rows.
p. Color green anteriorly, coffee-brown posteriorly .... *dimidiatus*
pp. Color green with darker cross-shades .... *zonatus*
ppp. Color nearly uniform anteriorly and posteriorly.
q. Back golden, much spotted anteriorly with clear blue .... *spilonotus, pulchellus, blochi, frenatus*
qq. Back without spots as above .... *globiceps, spinus, pronus, jenkinsi, fumifrons, kelloggi, tricolor, dussumieri, pyrrhostethus, pepo, fasciatus*
lll. Lips and scales on cheeks undescribed .... *festivus, frontalis, forsteri*
aa. PSEUDOSCARUS. Jaws green or blue.
r. Coloration largely dark red, the jaws deep blue; lip largely covering upper jaw; scales on cheek in three rows.
s. Head without green markings .... *prasiognathus*
ss. Head with dark green streaks and markings .... *mauricus*
rr. Coloration brown, the fins black-edged .... *nuchipunctatus*
rrr. Coloration largely deep green or blue.
t. Lip covering less than half of upper jaw.
u. Scales on cheek in two series .... *latax, celebicus, cypho, troscheli, macleayi, gymnognathos*
uu. Scales on cheek in three rows .... *jordani, strongylocephalus, microrhinos*
tt. Lip covering more than half of upper jaw.
v. Scales on cheeks in two rows; belly with blue streaks .... *cyanogrammus*
vv. Scales on cheeks in three rows .... *ultramarinus, lazulinus, cyanognathus*
ttt. Lips and scales undescribed .... *mertensi, spilurus, waitei*

1042. Callyodon pyrrhurus Jordan & Seale, new species. *Fuga mumu.* Samoa.

Head 2.75 in length; depth 3.75; eye 7.50 in head; dorsal IX, 10; anal III, 9; scales 2–24–6; two rows of scales on cheek; lower limb of preopercle bare; snout 2.13 in head; interorbital 3.10.

Body oblong, compressed; anterior part of head bluntly rounded, the snout slightly gibbous; depth of caudal peduncle 2.70 in head; a pair of strong posterior canines on upper jaw, none on lower; lips rather narrow, the upper scarcely covering one-half and the lower about one-third of teeth; base of dorsal fin 1.78 in length without caudal, its longest ray 3 in head; base of anal 1.45 in head, 2.16 in base of dorsal; pectoral 1.45 in head; ventral 1.98; caudal 2, truncate or slightly lunate.

Color in spirits olive-brown, the base of scales slightly darker; chin and thorax with slight wash of yellowish; tip of lips yellowish; indistinctly yellowish from eye to angle of mouth; dorsal fin blackish, with some yellowish mottlings on posterior third of soft dorsal; anal fin dusky, unmarked; pectoral dusky, more or less blotched with bluish wash; ventral similar to pectoral; caudal bright yellow, its 3 margins with a narrow line of black; iris yellow; teeth greenish.

Color in life of a specimen from Apia, clear olivaceous sooty, a little paler on tail; axil olive-black; dorsal, anal, pectoral and ventral like body, dorsal and pectoral with black edge; caudal deep brownish red, with a blackish edge.

Another specimen from Apia was dark purplish gray, almost black; throat and belly about the same; a little olive on throat; first dorsal, pectoral and ventral like body; axil blackish; soft dorsal washed with red; caudal clear dark red, edged with black, the upper and lower rays dusky.

Life colors of a specimen from Pago Pago, dark purplish gray, centers of scales blackish; axil dark; dorsal, anal, ventral and pectoral black; soft dorsal dull orange with a black edge (some velvety green-black); caudal brilliant scarlet, its edge dark.

Eight specimens from Apia and Pago Pago. The type is no. 51748, U. S. National Museum, from Pago Pago, length 9.75 inches.

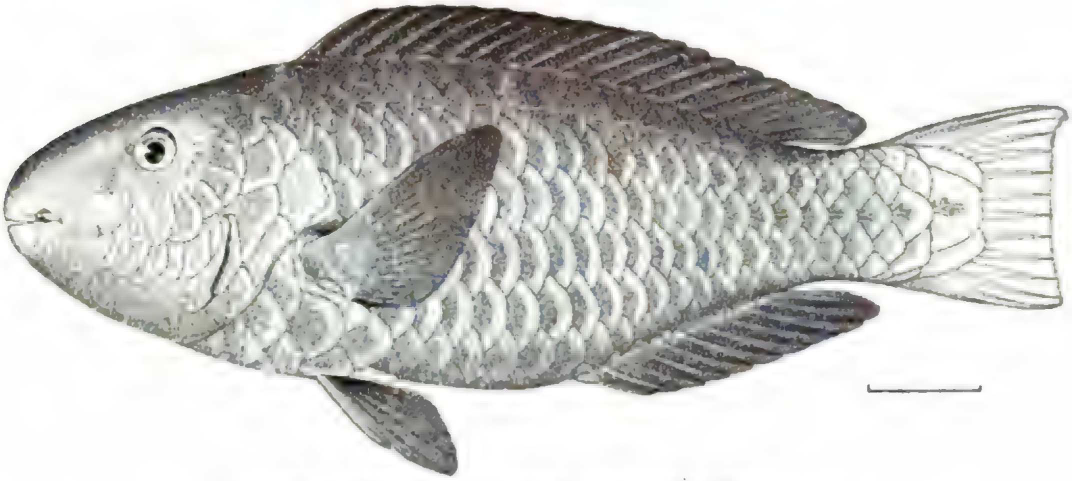


FIG. 55.—*Callyodon pyrrhurus* Jordan & Seale, new species. Type.

1043. Callyodon bennetti (Cuvier & Valenciennes). *Amasapupema.* Hawaii; Samoa.

Scarus bennettii Cuvier & Valenciennes, Hist. Nat. Poiss., XIV, 270, **Sandwich Is.** Jenkins, Bull. U. S. Fish Comm., XXIII, 1903, 470, Honolulu.

We have 6 examples of this fish, from Apia. Teeth rosy, dusky at base, uncovered; no canines; two rows of scales on cheek; caudal truncate.

Life colors of a specimen from Apia, blackish brown, a bronze-black area on each scale; snout, lips, and below bright dark cinnamon; belly dark red-brown; dorsal cinnamon, mottled and dark edged; caudal truncate, soiled red-brown; anal similar, almost black; ventral similar to anal; pectoral dark brown, fading below; axil dark.

Another specimen from Apia was violet brown, clear on belly, darker on back; sides olive shaded, the scales mottled; forehead, chin and throat vinous red brown; dorsal deep vinous brown, blackish on edge; caudal similar, paler, a broad dusky shade at tip; axil with a dark cross-shade; anal and ventral like dorsal; pectoral a little paler.

1044. Callyodon platodon (Seale). Guam.

Pseudoscarus platodoni (misprint) Seale, Bishop Museum 1901, 96, **Guam.**

1045. Callyodon miniatus (Jenkins). Hawaii.

Scarus miniatus Jenkins, Bull. U. S. Fish Comm., XIX, 1899 (Aug. 30, 1900), 62, fig. 20, **Honolulu.**

1046. Callyodon goldiei (Macleay). New Guinea.

Pseudoscarus goldiei Macleay, Proc. Linn. Soc. N. S. W. 1883, 590.

1047. Callyodon borborus (Jordan & Evermann). Hawaii.

Scarus barborus (misprint for *borborus*) Jordan & Evermann, Bull. U. S. Fish Comm., XXII, 1902 (1903), 197, **Honolulu.**

1048. Callyodon labiosus (Macleay). New Guinea.

1049. Callyodon ruberrimus Jordan & Seale, new species. *Fuga ulapo.* Samoa.

Head 2.75 in length; depth 3.20; eye 8.25 in head; dorsal IX, 10; anal III, 9; scales 2–24–6; three rows of scales on cheek, the lower row of only 2 scales, almost covering lower limb of preopercle.

Body elongate, compressed, the anterior of head bluntly rounded, the snout somewhat gibbous; depth of caudal peduncle 2.85 in head; six rows of scales in front of dorsal; a single posterior canine of small size in upper jaw; lips narrow, covering only one-half, or less than one-half, of teeth, the upper lip narrower than lower; base of dorsal 1.85 in head, its longest ray 3 in head; base of anal 1.85, 2.75 in base of spinous dorsal, its longest ray 3.10 in head; pectoral 1.50; ventrals 2; caudal deeply lunate, exposed outer ray 1.80; exposed midray 4.

Color in life of a specimen from Apia, clear reddish brown; coppery red on throat, breast and belly; each scale with three radiating marks of dark brown; lips red. Dorsal reddish brown, dusky edged; caudal dark brownish red; other fins brownish red, a little paler; ventral bright red; teeth pale.

Color in spirits, dull olive-brown, lighter below, being yellowish white on under part of head and body; lips without color bands, the tips being yellowish; there is a wide dark bar of color descending vertically from fourth to seventh dorsal spines to belly; in most of its length the bar is indistinct and made up of black spots, but beneath the posterior part of pectorals it is very distinct; a blackish spot at angle of mouth; a slight trace of a dusky line from lower part of orbit to axis of mouth; a whitish blotch on gill-membranes at isthmus; three dark olive radiating marks on each scale; dorsal fin dull pale green, darker posteriorly, the margin dusky; anal dull grayish green; pectoral brownish, the posterior portion becoming yellowish; ventral dull yellowish; caudal olive-brown; iris golden; teeth pale.

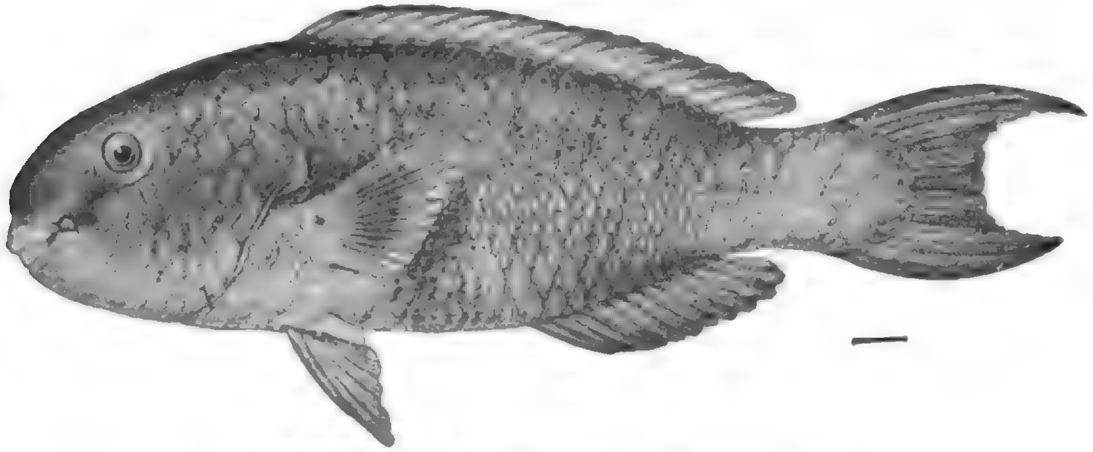


FIG. 56.—*Callyodon ruberrimus* Jordan & Seale, new species. Type.

One specimen from Pago Pago, Samoa. Type, no. 51749, U. S. National Museum, length 20.25 inches.

1050. Callyodon purpureus (Cuvier & Valenciennes). Samoa; Ulea.

Scarus purpureus Cuvier & Valenciennes, Hist. Nat. Poiss., XIV, 277, 1839, **Ulea.**

Head 2.75 in length; depth 2.75; eye 7.25 in head; dorsal IX, 10; anal III, 9; scales 2–24–6; two rows of scales on cheek, the lower limb of preopercle bare; snout 2.25; interorbital 3.10.

Body oblong, compressed; anterior profile bluntly rounded, upper jaw prominent; depth of caudal peduncle 2.25 in head; a very small posterior canine in upper jaw; lips narrow, scarcely covering one-half of upper jaw and less than one-half of lower; five rows of scales in front of dorsal; base of dorsal 1.75 in length without caudal, its longest ray 2.95 in head; base of anal 1.50 in head, 2.30 in base of dorsal; pectoral 1.40; ventral 2.10; caudal slightly rounded.

Color in spirits, dull olive brown; a purplish wash on top of head and snout, lighter on under part of head, thorax and belly; 3 or 4 indistinct darker lines on side of belly; caudal peduncle with a large roundish black blotch at base of caudal; tip of lips yellowish; caudal and anal dark brown, without markings; pectoral yellowish; ventral yellowish, splashed with brown; caudal yellowish, shaded with irregular blotches of brown; a fine line of gray at the tip with darker intermargin; iris golden; teeth white.

In life dark purplish brown, almost unmarked, but with a large rounded blackish blotch at base of caudal.

Three specimens from Apia. The specimen described is 9.35 inches long.

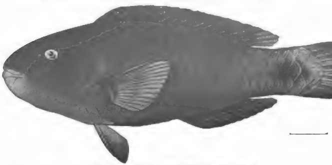


FIG. 57.—*Callyodon purpureus* (Cuvier & Valenciennes).

1051. Callyodon filholi (Sauvage). Fiji.

Pseudoscarus filholi Sauvage, Bull. Sci. Philom. 1880, 15 (reprint). **Fiji.**

1052. Callyodon erythrodon (Cuvier & Valenciennes). *Fuga 'uausai.* Samoa; Laysan; Tahiti and Faté (Seale).

Scarus erythrodon Cuvier & Valenciennes, Hist. Nat. Poiss., XIV, 255, 1839, **Ile de France.**
Scarus sumbawensis Bleeker, Banda, V, 104, **Sumbawa.** Seale, Bishop Museum 1901, 97, Guam. Steindachner, Denk. Ak. Wiss. Wien 1900, Laysan.

Head 2.75 in length; depth 3; eye 7 in head; snout 2.35; interorbital 3; dorsal IX, 10; anal III, 9; scales 2-24-6; two rows of scales on the cheek, the lower opercular limb naked.

Body oblong, compressed, the anterior profile of head bluntly rounded; depth of caudal peduncle 2.75 in head; no posterior canines; upper lip broad, covering more than two-thirds of teeth, lower lip covering one half of teeth, in the young the teeth are fully covered; four rows of scales in front of dorsal; base of dorsal 1.75 in length without caudal, its longest ray 3.75 in head; base of anal 1.50, 2.25 in base of dorsal; pectoral 1.50; ventral 2.10; caudal slightly rounded.

Life colors of a specimen from Pago Pago, dark purplish brown, the scales lighter edged, the belly tinged with bright red; dorsal reddish brown, clear behind, finely mottled with dark olive, edged with blackish; caudal dull violet brown, with some darker mottlings and a pale edge; anal dusky wine color, with a dark and a pale edge; ventral vermilion, rather bright; pectoral dull brownish, translucent behind.

Color in spirits, violet-olive, dorsal and anal fins darker, without distinctive markings; pectoral yellowish gray; ventrals grayish, darker at tips, caudal grayish with dusky blotches more or less in form of bands, a very narrow line of gray at margin with submarginal dusky area; usually a dusky blotch posterior to eye; iris golden; lips yellowish; teeth white.

Numerous specimens from Pago Pago. The specimen described is 8.30 inches long.

1053. Callyodon moensi (Bleeker). Tahiti and Faté (Seale); Celebes.

Scarus moensi Bleeker, Celebes, XIII, 51.

1054. Callyodon brunneus (Jenkins). Hawaii; Samoa.

Scarus brunneus Jenkins, Bull. U. S. Fish Comm., XIX, 1899 (1900), 59, fig. 16, **Honolulu.**

We have 2 specimens from Apia which agree with cotypes of this species from Honolulu.

1055. Callyodon erythacus Jordan & Seale, new species.

Head 3 in length; depth 3.10; eye 7 in head; snout 2.65; interorbital 3.25; dorsal IX, 10; anal III, 9; scales 2-24-6, two rows on cheek; lower limb of preopercle bare.

Body oblong, compressed; anterior of head evenly rounded and rather blunt; depth of caudal peduncle 2.01 in head; a pair of large posterior canines in upper jaw, none on lower jaw; lips wide, almost covering teeth; three scales in front of dorsal; base of dorsal 1.25 in head, its longest ray 2.35; base of anal 120, 2.14 in base of dorsal; pectoral 1.20 in head; ventral 1.75; caudal lunate, outer exposed ray 1.95, exposed middle ray 3.95.

Color in life, dirty purplish brown; belly coppery red; head plain; dorsal brown, blackish at margin anteriorly, pale posteriorly; a white streak along base of dorsal spines; caudal purplish brown, with pale edge; anal mottled brown with dark and pale edge; ventral mottled coppery brown-red; pectoral pale; dark in axil; caudal lunate.

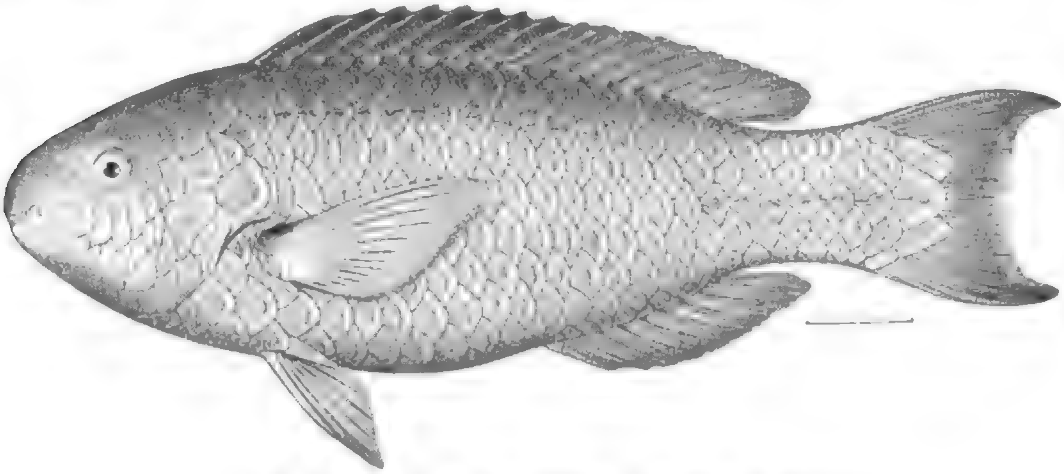


FIG. 58.—*Callyodon erythacus* Jordan & Seale, new species. Type.

Color in spirits, dull olive-brown, the base of scales darker, under part of head and belly lighter; three more or less distinct whitish lines along side of belly; a dusky blotch on axil and on posterior part of opercle; a dusky blotch on upper part of eye; top of head dull greenish; lips without distinct bands except two slight traces of greenish around lower lip; dorsals dusky, the membranes around the spines gray; some gray blotches between the bases of the rays, a slight wash of gray on posterior tip of fin; anal dusky, some grayish blotches at base; pectoral grayish; ventral grayish; caudal mottled dusky with grayish posterior tip.

This species is close to *Callyodon lacerta*, differing in the pale or red breast, in purplish, not orange, edge to fins, and in having but two rows of scales on cheek. The jaws are well covered, and posterior canines present.

One specimen, the type no. 51750, U. S. National Museum, from Apia, length 10.50 inches.

1056. Callyodon ahula (Jenkins). Hawaii.

Scarus ahula Jenkins, Bull. U. S. Fish Comm., 1899 (1900), 61, fig. 19, **Honolulu.** Snyder, Bull. U. S. Fish Comm., 1902 (1904), 531, Honolulu.

1057. Callyodon mutabilis Gronow. New Guinea (Macleay); Shortland I. (Seale); Celebes; Amboina.

Calliodon mutabilis Gronow, Cat. Fish., ed. Gray, 1854, 86, **Amboina.**
Pseudoscarus pentazona Bleeker, Atlas, I, Scar., 46, tab. XI, fig. 1, **Celebes.**

1058. Callyodon dubius (Bennett). Hawaii; Samoa; Tahiti; Tubuai and Raiatea (Seale).

Scarus dubius Bennett, Zool. Jour., IV, 37, **Sandwich Is.**
Pseudoscarus dubius Günther, Cat., IV, 229, Sandwich Is., Fiji Is.

We have 3 specimens of this species from Apia.

1059. Callyodon lacerta (Cuvier & Valenciennes). Samoa; East Indies.

Scarus lacerta Cuvier & Valenciennes, Hist. Nat. Poiss., XIV, 217, 1839, **Pondicherry.**
Pseudoscarus æruginosus Günther, Cat., IV, 229; not *Scarus æruginosus* Cuvier & Valenciennes.

This is the commonest *fuga*, or parrot-fish, at the Samoan Islands. We have about 60 specimens from Apia and 16 from Pago Pago.

Head 3.10 in length; depth 2.75; eye 6.50 in head; dorsal IX, 10; anal III, 10; scales 2–24–6, three rows on cheek, the lower row of 4 scales on lower limb of preopercle.

Body oblong, compressed, the anterior profile bluntly rounded; depth of caudal peduncle 2.10; a posterior canine in upper jaw; lips wide, fully covering all but tip of teeth; five scales in front of dorsal fin; base of dorsal 1.75 in length of fish without caudal, its lower ray 3.14 in head; base of anal 1.25 in head, 2.50 in base of dorsal, its longest ray 3.75 in head; pectoral 1.14; ventral 2; caudal rather deeply lunate 1.14. The specimen described is 9.55 inches long, from Pago Pago.

Life colors of various specimens were as follows:

(1) Dark dull purplish olive; chin and space below eye paler; vertical fins marbled with dull reddish purple, no clear markings; a dark bar across throat. Specimen from Apia.

(2) Also from Apia. Dull olive, shaded with lilac-brown; a blackish blotch above pectoral; base of pectoral dusky; fins all dull lilac-brown.

(3) From Pago Pago. Dirty mottled blackish olive; iris dusky; three silver streaks along side of belly; axil black; dorsal mottled with salmon colored patch at tips of third and fourth spines; caudal brown mottled, tips paler; anal dusky; pectoral and ventral mottled olive.

(4) From Pago Pago. Body mottled olive-brown; iris golden; three dull silvery streaks along side of belly; axil black; dorsal olive with salmon tinge, edge black; caudal dull olive, medially salmon; anal blackish; pectoral brownish, tinged with salmon; ventral dirty gray.

(5) From Pago Pago. Dark olive-brown, more olive on cheek; three well defined whitish streaks along side of belly; belly dark, like sides, or a little paler; dorsal dark reddish brown, with an orange edge; caudal pale and redder, but still plain reddish brown; anal a little darker; pectoral and ventral similar; forehead darker brown; a dark axillary spot.

(6) From Pago Pago. Purplish brown, with olive shades along sides; reddish on breast; dorsal reddish, edged with purplish; caudal plain reddish brown, lunate; pectoral dull orange, the lower rays purplish; ventral redder; anal olive and purplish; a dark shade across branchiostegal region.

Color in spirits, a dull olive-brown, lighter below, 3 distinct white lines on each side of belly and a wide indistinct blackish band-like area on side below posterior two-thirds of spinous dorsal, invading the lighter coloring of the belly; top of snout with slight wash of purplish; dorsal brownish, unmarked; anal brownish, lighter at base; pectoral grayish; ventral yellowish, gray at tip; caudal brownish, unmarked; iris golden; teeth white.

1060. Callyodon lepidus (Jenyns). Tahiti; Rarotonga (Seale).

Scarus lepidus Jenyns, Zool. Beagle, Fish., 108, 1842, **Tahiti.**

1061. Callyodon paluca (Jenkins). Hawaii.

Scarus paluca Jenkins, Bull. U. S. Fish Comm., 1899 (1900), 60, fig. 18, **Honolulu.** Snyder, Bull. U. S. Fish Comm., 1902 (1904), 531, Honolulu.

1062. Callyodon upolensis Jordan & Seale, new species. Samoa.

Head 3 in length; depth 3; eye 4.95 in head; dorsal IX, 10; anal III, 9; scales 2–24–6, three rows on cheek, the lower row of three scales on lower limb of preopercle; snout 3 in head; interorbital 3.18.

Body oblong, compressed; anterior profile rather pointed; depth of caudal peduncle 2.55 in head; no posterior canines; lips wide, almost covering tip of teeth; base of dorsal fin 1.85 in length without caudal, its longest ray 2.50 in head; base of anal fin 1.50 or 2.50 in base of dorsal; pectoral 1.45 in head; ventral 1.98; caudal almost square, the upper and lower margin of fin scarcely produced.

Color in spirits, dull brown, the center of each scale lighter, giving the appearance of about 8 lighter longitudinal stripes; tip of snout, chin, thorax, and belly a shade lighter than body color, the lips and side of snout with slight wash of dull yellowish; a yellowish blotch on opercle; dorsal fin dull yellowish with wash of dusky and a darker margin; anal, ventral, and caudal yellowish with wash of dusky; pectoral yellow; iris yellow; teeth white.

The young are similar in coloring to adults, except that the fins do not show so much dusky, being without the dark tip to dorsal, but with a narrow dark line at base of dorsal and anal.

Three specimens from Apia, 2.10 to 4.50 inches long. The type is no. 51751, U. S. National Museum, 4.50 inches long, from Apia.

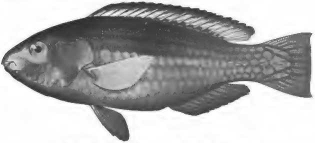


FIG. 59.—*Callyodon upolensis* Jordan & Seale, new species. Type.

1063. Callyodon macrocheilos (Bleeker). Faté, New Hebrides (Seale); East Indies.

(*Scarus macrocheilos* Bleeker, Gilolo, 60.)

1064. Callyodon balinensis (Bleeker). *Fuga pa'i; Fuga pa'ipa'i; Fuga mea.* Samoa; East Indies.

Scarus balinensis Bleeker, Verh. Bat. Gen., XXII; Bijdr. Ichth. Bali, 8.
Pseudoscarus balinensis Bleeker, Atlas, I, 39, tab. XVI, fig. 3, Bali, Banda.

Head 3.10 in length; depth 3.10; eye 6.50 in head; dorsal IX, 10; anal III, 9; scales 2-24-6, three rows on cheek, the lower row of three scales on lower part of preopercle; snout 2.50 in head; interorbital 3.10.

Body oblong, compressed, rather elongate; the anterior of head rather pointed; depth of caudal peduncle 2.12 in head; no posterior canines; lips wide, covering all but small tip of jaws; seven rows of scales in front of dorsal; dorsal 1.85 in length without caudal, its longest ray 2.75 in head; base of anal 1.20 in head, 1.25 in base of dorsal, its longest ray 3 in head; pectoral 1.25 in head; ventral 1.70; caudal moderately lunate, 1.12 in head.

Color in spirits, dull, grayish, lighter below; four yellowish lines along sides of belly, lower lip yellowish, upper lip grayish; a slight dusky wash on posterior margin of opercle and at axis of pectoral; dorsal grayish with dark margin, and a lighter submarginal line, the fin somewhat splashed with yellowish; anal yellowish, with dark margin, and a few dusky blotches at base; pectoral yellowish; ventral yellowish, with narrow indistinct darker margins; caudal dark grayish; a fine line of gray at tip, with a narrow submarginal dusky line; iris golden; teeth white.

Description of a specimen 11 inches long, from Apia. We have 10 specimens from this locality.

Life colors of one specimen drab, the scales above edged with bronze brown; a faint diffuse blotch of darker drab on lateral line, above vent; dorsal gray with a brownish reddish submarginal band, the edge bluish gray; caudal grayish olive, darker at edge; anal light reddish brown, the edge bluish; ventral pale reddish; pectoral rather bright yellow, axil black; head plain gray.

Another specimen in life was rather light brown, the belly pinkish brown; each scale above margined all around with clear olive brown; lower jaw abruptly pale brown with shades of livid bluish; dorsal dull orange, grayish at base, with a blue-black edge; anal brighter orange, with a broader edge of blue black; caudal grayish at base, then sooty brown, the edges dusky blue; ventral light orange, edged with bluish; pectoral dusky yellow, edged before with bluish; lips reddish, the upper dark; side of belly with three pale stripes.

1065. Callyodon oviceps (Cuvier & Valenciennes). *Fuga uli.* Tahiti; Samoa.

Scarus oviceps, Cuvier & Valenciennes, Hist. Nat. Poiss., XIV, 244, Tahiti.
Pseudoscarus oviceps, Günther, Cat., IV, 225; copied from Valenciennes.

Head 3.10 to end of vertebræ; depth 3.10; eye 6.75 in head; dorsal IX, 10; anal III, 8; scales 2–24–6; three rows on cheek, the lower row of three scales on lower limb of preopercle.

Body oblong, compressed, the anterior of head broadly rounded, the snout in front of eye slightly gibbous; depth of caudal peduncle 2.10 in head; no posterior canines; lips broad, covering teeth; six scales in front of dorsal; longest ray of dorsal 2.75 in head; base of anal 1.14, 1.95 in base of dorsal, its longest ray 3.10 in head; pectoral 1.30 in head; ventral 1.90; caudal lunate 1.18.

Life colors of an immature example from Apia, light olive, golden on sides of head; below a dark brown diffuse band from snout through eye to gill-opening; two diffuse yellowish shades from spinous dorsal downward, a darker area between; fins dull pinkish olive, the caudal darker above and below; the ventral almost white.

An adult example, also from Apia, was dusky mottled olive, almost black on back anteriorly; a dull golden area bounding the black, from cheek to end of pectoral, then obliquely upward; another yellow blotch on back behind it; a whitish stripe below eye bounding the yellow; dorsal reddish brown with a black edge which fades behind; caudal lunate, dull orange brown; anal brownish red, rather bright, paler at base; ventral colorless; pectoral colorless, blackish above toward tip; lips reddish brown; chin and below clear brown, the belly whitish. Brighter colored than the preceding specimen.

A specimen from Pago Pago was slaty blackish above; broad pale greenish-yellow blotch below eye and running up to dorsum about even with tip of pectoral when laid back; below whitish; ventrals and anal thin salmon scarlet; dorsal with blackish margin and base, and broad median, rather dark, reddish band; pectoral dark near anterior margin, then yellowish, then uncolored.

Color in spirits brownish, darker above, a yellowish band from middle of dorsal fin obliquely down to point of pectorals, a similar but much smaller and less distinct band down from middle of soft dorsal; upper part of head dusky with bluish wash distinctly separated from yellowish lower half of head by a dark line from snout through lower part of eye to posterior margin of opercles; tip of the lips yellowish; dorsal brownish with yellowish blotches, the posterior tip of fin being yellowish; anal, pectoral, and ventral yellowish, unmarked. Some specimens show a slight dusky wash on pectoral; caudal grayish; iris golden; teeth white.

Seven specimens from Apia and 5 from Pago Pago. The one described is 8.55 inches long, and was obtained at Apia. The species is rather common at Samoa.

1066. Callyodon zonularis Jordan & Seale, new species. *Fuga mea.* Samoa.

Head 3 in length; depth 3; eye 6.75 in head; snout 2.10; interorbital 2.85; dorsal IX, 10; anal III, 9; scales 2–24–6, three rows on cheek, the lower row of four scales, covering the lower limb of preopercle.

Body oblong, compressed; snout gibbous; caudal peduncle thick and strong, its depth equal to snout; no canines; lips covering more than two-thirds of upper teeth; gill-rakers small, numerous; opercle and preopercle entire; six scales in front of dorsal; origin of dorsal over posterior margin of opercle; longest dorsal spine 3.20 in head, the longest ray 2.50; base of anal 1.50, 2.30 in base of dorsal, its longest ray 3 in head; pectoral 1.20; ventral 1.98, its origin on line with middle of base of pectoral; caudal square.

Life colors of a specimen from Apia, olive yellow, clear golden in a bar behind pectoral; back with four dusky crossbars overlying yellow; a blackish shade on side of head across eye; breast and lips creamy reddish; fins all yellow, shaded like neighboring parts of body, the pectoral clear yellow; traces of pale golden streaks along side of belly; also a diffuse yellow lateral stripe.

A specimen from Pago Pago had a pale greenish yellow suffusion over body; four indistinctly marked smoky bands from dorsum half way down sides, fading ventrally; belly yellowish whitish, also ventral; cheeks rather yellow; lips saffron; black bar behind eye; caudal reddish saffron.

Color in spirits grayish white, with 5 wide oblique bands of black which extend over back and to about the median line of sides, the bands of greater width than the interspaces, the first at origin of spinous dorsal, and more or less amalgamated with the dusky upper half of head, the second band from fifth to eighth dorsal spines, the third from first to fifth dorsal rays, the fourth from seventh to tenth dorsal rays, and the posterior band, which is very indistinct and more or less united with the fourth, on the middle portion of caudal peduncle; a black band from eye to posterior margin of opercle, the dusky upper half of head sharply separated from lighter lower half by a line of dusky with a whitish line below it, extending from orbit to angle of mouth; lips yellowish; teeth yellowish; iris dusky with inner ring of golden; dorsal grayish, the dusky bands of body invading the fin more or less; caudal grayish; pectoral, ventral, and anal yellowish white, unmarked.

This strongly marked species is common at Samoa; we have three examples from Apia and ten from Pago Pago.

Described from the type, no. 51752, U. S. National Museum, from Pago Pago, length 10.50 inches.

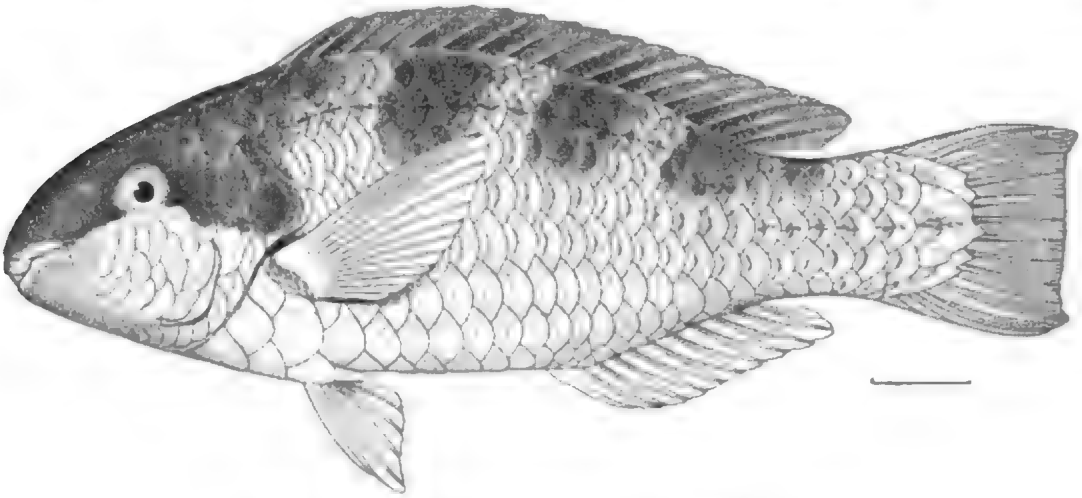


FIG. 60.—*Callyodon zonularis* Jordan & Seale, new species. Type.

1067. Callyodon roseiceps (Cuvier & Valenciennes). Ulea, Caroline Is.

Scarus roseiceps Cuvier & Valenciennes, Hist. Nat. Poiss., xiv, 279, 1839, **Ulea.**

1068. Callyodon cruentatus (Cuvier & Valenciennes). Ulea.

Scarus cruentatus Cuvier & Valenciennes, op. cit., xiv, 277, **Ulea.**

1069. Callyodon ocellatus (Cuvier & Valenciennes). Caroline Is.

Scarus ocellatus, Cuvier & Valenciennes, op. cit., xiv, 278, **Caroline Is.**
Pseudoscarus ocellatus, Günther, Cat., iv, 233; after Valenciennes.

1070. Callyodon perspicillatus (Steindachner). Hawaii; Johnston I.

Scarus perspicillatus Steindachner, Denks. Ak. Wiss. Wien, xli, 1879, 16, taf. iv, fig. 1, **Sandwich Is.** Smith & Swain, Proc. U. S. Nat. Mus. 1882, 134, Johnston I. Jenkins, Bull. U. S. Fish Comm., xxii, 1902 (1903), 470, Honolulu. Jordan & Evermann, Bull. U. S. Fish Comm., xxiii, 1903 (1905), 347, fig. 149. Honolulu, Puako Bay, Johnston I.

This large and beautiful scaroid is rather rare. It is highly esteemed by the Hawaiians as a food fish.

1071. Callyodon brighami (Bryan & Herre). Marcus I.

Scarus brighami Bryan & Herre, Bishop Museum, 1903, ii, 131, **Marcus I.**

Described from a single specimen collected at Marcus Island by William Alanson Bryan.

1072. Callyodon quoyi (Cuvier & Valenciennes). New Ireland; Shortland I. (Seale); East Indies.

Scarus quoyi Cuvier & Valenciennes, Hist. Nat. Poiss., xiv, 273, 1839, **New Ireland.** Bleeker, Ternate, ii, 607, Ternate.
Pseudoscarus quoyi, Bleeker, Atlas Ich., i, 29, tab. vi, fig. 3, Ternate. Günther, Cat., iv, 239; after Bleeker.

1073. Callyodon lupus (Fowler). Thornton I.

Scarus lupus Fowler, Proc. Acad. Nat. Sci. Phila. 1899, 491, Thornton I.

1074. **Callyodon jonesi** (Streets). Fanning Is.

Scarus jonesi Streets, Bull. U. S. Nat. Mus., vii, 1877, **Fanning I.**

1075. **Callyodon papuensis** (Macleay). New Guinea.

Pseudoscarus papuensis Macleay, Proc. Linn. Soc. N. S. W. 1883, 600.

1076. **Callyodon moresbyensis** Macleay. New Guinea.

Pseudoscarus moresbyensis Macleay, l. c., **New Guinea.**

1077. **Callyodon bataviensis** (Bleeker). *Tapoli*; *Laea mumu.* Samoa; Guam; East Indies.

Scarus bataviensis Bleeker, Java, iv, 342, **Batavia.** Seale, Bishop Museum 1901, 96, Guam.
Pseudoscarus bataviensis Bleeker, Atlas Ichth., 48, tab. xii, fig. 3, Batavia.

Head 3 in length; depth 3.10; eye 6.75 in head; dorsal ix,10; anal iii,9; scales 2-24-6; two rows of scales on cheeks, the lower of six scales; lower limit of preopercle bare; lips wide, covering two-thirds or more of teeth; snout 2.50 in head; interobital 1.20 in head.

Body oblong, compressed, the anterior profile evenly pointed; depth of caudal peduncle 2.10 in head; tubules of lateral line usually with but one or two very short branches; a strong posterior canine above and below; four scales in front of dorsal; longest dorsal spine 3 in head, the longest ray 2.75 in head, base of anal 1.25 in head; 2 in base of dorsal; pectoral 1.20 in head; ventral 1.75 in head; caudal deeply lunate, length of exposed outer ray 1.25 in head, exposed inner ray, 6 in head.

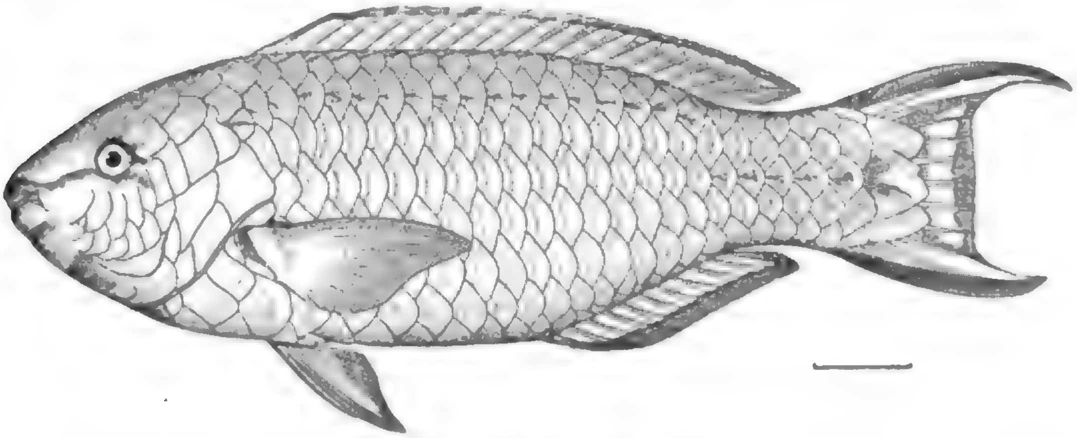


Fig. 61.—*Callyodon bataviensis* (Bleeker).

Life colors of a specimen from Apia, olive-green, with shades of rich light brown on side, becoming purplish olive on head, purplish gray on forehead and clear blue-green behind, the shades changing gradually; green stripes about eye; lips clear blue; a blue stripe across creamy red of lips; centers of scales on caudal peduncle dusky; dorsal orange, with a bluish dull median shade; a bright blue stripe at base and edge; caudal lunate, bright blue, especially on the margin, with shades of light grayish orange-brown; anal orange-brown, the margin blue with a bright orange-red stripe; pectoral blue, deeper above; axil blue; teeth white.

Color in spirits dull gray with wash of yellowish, the center of scales on posterior half of body showing a slight tint of pale green, darker on top of head; a bright green line through lower part of orbit along side of snout and around upper lip; also a green line on lower lip; chin yellowish, with a green cross-band and a green triangular patch on lower part of head uniting with its fellow on opposite side at middle of isthmus; a green line from isthmus through ventrals, along base of anal to caudal; two indistinct greenish lines on each side of belly; a dusky blotch on upper part of orbit; dorsal with a rather irregular broad yellowish margined center of green, the tip of fin with a broad line of deep green, a more or less broken line at base; outer third of anal deep green, the inner two-thirds yellowish, a narrow green line at base; pectoral greenish, slightly darker at axil; ventral with mid-portion yellowish surrounded by a broad green margin; caudal with outer rays, posterior margin, and base green, the inner portion of fin and two or three rays of each lobe yellowish white.

Of this species we have 5 specimens from Apia.

1078. Callyodon gilberti (Jenkins). Hawaii; Laysan.

?*Scarus bataviensis*, Steindachner, Denk. Ak. Wiss. Wien, LXX, 1900, 508, Honolulu, Laysan.
Scarus gilberti Jenkins, Bull. U. S. Fish Comm., 1899 (1900), 59, fig. 17, **Honolulu.**

This scaroid is rather rare at Honolulu. It is close to *C. bataviensis*, but apparently distinct.

1079. Callyodon abacurus Jordan & Seale, new species. *Fuga meamea.* Samoa. (Pl. XXXIII.)

Head 2.85 in length; depth 2.90; eye 8.50 in head; snout 2.20; interorbital 3; dorsal IX, 10; anal III, 9; scales 2–26–6, two rows on cheek, the lower preopercle limb bare.

Body oblong, compressed, the anterior profile bluntly rounded, the snout slightly gibbous; two large posterior canines on upper jaw, none on lower; upper lip broad, covering two-thirds or more of upper jaw; lower lip narrow, covering less than half of jaw; depth of caudal peduncle 2.45 in head; longest ray of dorsal 3; base of anal 1.30, 2.10 in base of dorsal; pectoral 1.35 in head; ventral 2; caudal slightly lunate.

Color in life of a specimen from Apia, bright green, the tail bright blue, a golden shade before it; belly creamy yellow; a dark shade behind pectoral; scales with broad brown bar which becomes an orange spot on posterior parts; cheeks green; forehead purplish olive; lips orange, yellow-edged, with a bright blue stripe across each, these meeting, running through the eye and sending a blue stripe to angle of mouth; the blue stripe green behind with an orange stripe below it; opercle edged with orange, preceded by a green stripe, a brown blotch above; dorsal bright blue with a continuous median stripe of golden; caudal (slightly lunate) bright blue, with golden bronze stripe on each lobe and cross spots and vermiculations at base; ventral golden with bright blue anterior edge; pectoral black, golden washed, and edged in front with blue.

A larger example is rather golden than green, the dusky purplish area above pectoral more marked, the dorsal and caudal with marks of purplish brown rather than orange; eye blue above a green streak before it. In all specimens the blue caudal peduncle has a large golden spot on each scale, giving a checkered appearance.

A specimen from Pago Pago was colored as follows: Upper and under lips, bars on under side of head, ventrals except a pinkish salmon median blotch, margin of dorsal and anal, and median longitudinal ventral line, all light blue; darker blue suborbital line from upper lip; postorbital blotches dark green next eye, lighter green farther back; top of head smoky olive green, farther back lighter green; body anteriorly yellowish-reddish-greenish with pinkish yellow coloration on sides of head and almost yellow on underside of head and bordering median ventral blue line; body posteriorly bluish-green with pinkish-yellowish-brown markings or checkers, one on each scale; portions of dorsal, anal, and caudal which are not blue, yellowish salmon.

Color in spirits, dull yellowish; caudal peduncle green with three longitudinal rows of round yellow spots; a broad dusky band occupying all the nuchal region to base of third dorsal spine, this band extending obliquely down and back on the side to a line with base of anal fin and lower margin of pectoral; margin of lips yellow; top of head and snout purplish; a green line with dark margins at upper margin of orbit, another short one at posterior margin of orbit, and a third from opercle along lower part of orbit down side of snout around upper lip, a branch descending to axil, and another branch around lower jaw posterior to yellow margin; dorsal fin yellowish white, the margin and base each with a band of green; anal colored similar to dorsal except the distal blue band is broader; pectoral dark purplish; ventral yellowish with a slight trace of bluish margins; caudal green with some scattered round yellowish spots, the middle portion of fin lighter; iris golden; teeth green.

We have 13 specimens of this beautiful species from the coral reef at Apia and 2 from Pago Pago. The type is no. 51754, U. S. National Museum, 12.75 inches long, from Pago Pago.

1080. Callyodon lauia Jordan & Evermann. Hawaii.

This may be the same as *Callyodon formosus.*

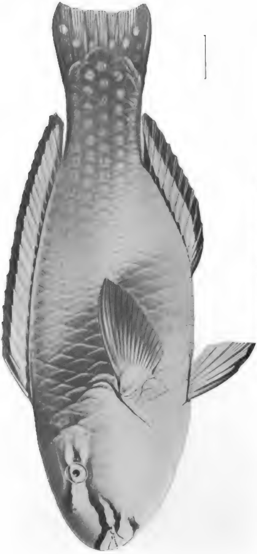
1081. Callyodon formosus (Cuvier & Valenciennes). Hawaii.

Scarus formosus Cuvier & Valenciennes, Hist. Nat. Poiss., XIV, 283, 1839, **Sandwich Is.**

The description of *Callyodon formosus* seems to apply fairly well to *Callyodon lauia.* *Callyodon jenkinsi* is also closely related.

1082. Callyodon dimidiatus (Bleeker). Papua; Shortland I. (Seale).

Scarus dimidiatus Bleeker, New Guinea, 17, **Papua.**



CALLYODON ABACURUS JORDAN & SEALE, NEW SPECIES. TYPE.

1083. Callyodon zonatus (Macleay). New Guinea.

Pseudoscarus zonatus Macleay, Proc. Linn. Soc. N. S. W. 1883, 501.

1084. Callyodon spilonotus (Kner). Samoa; Fiji. (Pl. xlviii, fig. 1.)

Pseudoscarus spilonotus Kner, Sitz. Ak. Wiss. Wien, lviii, 60, taf. ix, fig. 26, 1868, **Kandavu (Fiji)**.

Head 3.12 in length; depth 2.85; eye 7 in head; snout 2.50; interorbital 2.75; dorsal ix,10; anal iii, 9; scales 2–24–6; three rows on cheek, the lower row of four scales on lower limb of preopercle.

Body oblong, compressed, the anterior profile bluntly rounded; depth of caudal peduncle 2 in head; a distinct upper and lower posterior canine; lips rather wide, covering more than half of upper jaw, and all but tip of lower jaw; five rows of scales in front of dorsal; base of dorsal 1.90 in length of fish without caudal, its longest ray 2.50 in head; base of anal 1.14, 1.95 in base of dorsal, its longest ray 2.75 in head; pectoral 1.20; ventral 1.75; caudal lunate.

Color in life of a specimen from Apia, deep blue, violet-brown-shaded on the back anteriorly, clear blue on the throat; creamy drab on the breast; anterior part of back down to pectoral closely spotted with bright blue-green; three blue stripes on side of belly and a median stripe; dorsal orange-brown, blue on edge, brighter behind, greenish blue at base; a row of round blue-green median spots; anal dull crimson, blue-green at base, blue on edge; caudal bright yellowish green, blue on angle, a purple red stripe on each lobe; ventral creamy, edged with blue; pectoral green with a violet-drab cross-bar at base and a violet-drab lengthwise stripe; throat bright blue; cheeks bright green; forehead bright violet-gray with a green cross-band and green stripes and spots behind eyes.

Another specimen from the same locality was deep greenish blue, tinged with reddish brown above, reddish below, each scale being brown at base; three blue-green stripes on side of belly; throat clear blue; snout and cheeks green blue; a brown band across eye, crossed by a green curved line; dorsal blue at base, the edge orange, with a row of green spots mesially; soft dorsal with more orange, the spots larger; caudal clear, green, with blue-green edges and a stripe of orange in each lobe; anal like dorsal, the red median stripe deeper orange-brown, the green spots smaller, the blue margin broader; pectoral blue-green, with long median orange-brown band; ventral blue-green, mesially orange-yellow.

A third specimen from Apia was deep bright orange-brown, more orange behind, the sides below becoming more pink, the belly orange yellow; the cheeks light vitriol-green, the lower jaw and throat clear livid blue, the upper jaw blue; two blue lines before eye, narrow, clear, and undulated; three behind eye, separated by orange-brown; head above dark brown, faintly spotted with dark blue; scales of anterior half of body above each with many small round blue spots, these coalescing in vermiculations behind eye; edge of opercle brown; posteriorly each scale centrally greenish blue, the brown forming broad edgings; caudal peduncle posteriorly bright green; sides of belly with one median (ventral line) and three other stripes, formed of a large blue spot on each scale, the hue of the ventral stripe sky-blue, the others progressively greener and more continuous; dorsal bright orange-brown, with a broad sky-blue margin, the basal scales bluish and green, the soft part with a median row of green spots; an irregular blackish blotch under third spine; caudal clear grass-green, edged above and below with bluish; an orange stripe along the next to lowest ray; a small orange spot at its base; anal dark orange, a broad sky-blue margin; bluish-green spots at base; ventral sky-blue in front, the rest orange-yellow; pectoral dusky in axil, an orange-brown band across base, the fin clear green, bluish above, with an orange-brown lengthwise stripe; some yellow edges to scales of lower part of head.

A specimen from Pago Pago was blue-green with yellowish-salmon scale spots; caudal grass-green with blue edging; on top of head orange-salmon markings; same color on dorsal and anal where not blue green; belly yellow white with robin's-egg-blue blotches; color in spirits, grayish with slight tints of green; upper half of body a shade darker and with scales of anterior half dotted with small round gray spots—three or four on each scale; three or four longitudinal green lines on sides of belly; tips of lips yellowish; about four greenish bands radiate from or pass through the eye, the lower one extending from opercles through lower part of eye around snout, joining its fellow of opposite side and dividing very distinctly the upper dark color of head from the lower lighter half. There is one additional green line around snout above this, and a short cross-line on anterior interorbital, a single green line around lower jaw; upper base of pectoral black; dorsal fin with a deep blue-green band at base, middle, and tip of fin, the fin otherwise yellowish; middle band more or less broken up into blotches; anal with bluish-green band at base and tip, the fin otherwise pale green; pectoral grayish green, blotched with darker above, dusky at base; ventral yellowish, the first rays pale green: caudal with upper and lower margins pale green, middle portion yellowish, iris golden, teeth white.

Six specimens from Apia. Description from a specimen 10 inches long.

1085. Callyodon pulchellus (Rüppell). New Hanover I.; East Indies.

Scarus pulchellus Rüppell, Neue Wirbelthiere, 25, taf. 8, fig. 2, 1835, **Red Sea.**
Pseudoscarus pulchellus Bleeker, Atlas, i, Scar., 34, tab. x, fig. 3, Java, Celebes. Günther, Cat., iv, 219, 1862, Mauritius, China. Peters, Berl. Mon. 1876, 843, New Hanover.

1086. Callyodon blochi (Cuvier & Valenciennes). New Guinea (Macleay); New Hanover (Peters); East Indies.

Scarus viridis Bloch, Ausl. Fische, taf. 222, 1790; not of Bonnaterre 1788.
Scarus blochi Cuvier & Valenciennes, Hist. Nat. Poiss., iv, 219, 1839, **Java.**
Pseudoscarus viridis, Bleeker, Atlas, i, Scar., 45, tab. xvii, fig. 2, East Indies. Peters, Berl. Mon. 1876, 843, New Hanover.
Scarus chrysopomus Bleeker, Verh. Bat. Gen., xxii; Labr. Cycl., 53, East Indies.
Pseudoscarus chrysopoma, Günther, Cat., iv, 221, 1862, East Indies.

We follow Peters in the arrangement of the synonymy of this species and the next, noting that the name *viridis* is preoccupied in *Callyodon*.

1087. Callyodon frenatus (Lacépède). New Hanover; Louisiades; East Indies.

Scarus frenatus Lacépède, Hist. Nat. Poiss., iv, 13, pl. 1, fig. 2, 1802, no locality.
Pseudoscarus frenatus, Bleeker, Atlas, i, Scar., 40, tab. xvi, fig. 2, Celebes. Peters, Berl. Mon. 1876, 844, New Hanover
Pseudoscarus viridis, Günther, Cat., iv, 220, Louisiades; not *Scarus viridis* Bloch, nor of Bonnaterre.

1088. Callyodon globiceps (Cuvier & Valenciennes). Tahiti.

Scarus globiceps Cuvier & Valenciennes, Hist. Nat. Poiss., xiv, 242, **Tahiti.** Jenyns, Voy. Beagle, Fishes, 106, Tahiti Günther, Cat., iv, 224, Tahiti.

1089. Callyodon spinus (Kner). Fiji.

Pseudoscarus spinus Kner, Sitz. Ak. Wiss. Wien 1868, 62, taf. ix, fig. 27, **Kandavu (Fiji).**

1090. Callyodon pronus (Fowler). Thornton I.

Scarus pronus Fowler, Proc. Acad. Nat. Sci. Phila. 1899, 490, **Thornton I.**

1091. Callyodon jenkinsi (Jordan & Evermann). Hawaii.

Scarus jenkinsi Jordan & Evermann, Bull. U. S. Fish Comm., xxii, 1902 (1903), 195, **Honolulu.**

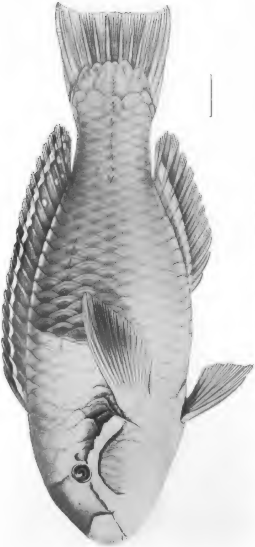
1092. Callyodon fumifrons Jordan & Seale, new species. Samoa. (Pl. xxxiv.)

Head 2.95 in length; depth 2.75; eye 8.50 in head; snout 2.01 in head; interorbital 2.75; dorsal ix, 10; anal iii, 9; scales 2–24–6, 3 rows on cheek, lower row of two large scales on lower limb of preopercle.

Body oblong, compressed; anterior of head bluntly rounded; upper jaw rather prominent; depth of caudal peduncle 2.12 in head; no posterior canines; lips very wide and thick, fully covering the lower teeth, and covering all but small tip of upper teeth; six scales in front of dorsal fin; base of dorsal fin 1.90 in length without caudal, its longest ray 2.75 in head; base of anal 1.25, 2 in base of dorsal, its longest ray 3 in head; pectoral 1.15 in head; ventral 1.95; caudal slightly lunate, length of exposed middle ray 2.20.

Life colors: Forehead, chin, and throat bright sky-blue; crown behind forehead with broad transverse bar of smoky lavender; angulated green-blue band from blue chin to eye and postero-ventrally to gill opening; behind eye color of crown with greenish brown suffusion; below suborbital band greenish brown; anterior half of dorsum and upper sides robin's-egg blue; dorsal with two pinkish-brown longitudinal lines with the included space bluish green; pectoral color of suborbital band with pinkish purple broad central space; ventral robin's-egg blue with sky-blue anterior margin; hinder half of body more dark greenish than front part and scales broadly edged basally with brownish growing pink brown posteriorly; caudal blue green with pink-brown markings at base; anal color of caudal with dark pink band along base; teeth white.

A young example had the following colors in life: Teeth white; lower lip sky blue; upper lip sky blue with narrow salmon margin; an angulated blue-green broad line from angle of mouth to eye and to gill opening; forehead smoky blue; below this band greenish brown with pink edging; above it a broad olive-brown band, then bright green; top of head violet-brown; pectoral bright blue, with dark purple median blotch; body blue green with pinkish-brown scale markings so arranged as to make on



CALLYODON FUMIFRONS JORDAN & SEALE, NEW SPECIES. TYPE.

posterior two-fifths of body green pentagons, with broad pinkish-brown borders; ventral sky-blue; anal green blue, with pink-salmon basal lines; caudal green blue with four complete and several short longitudinal bars of pinkish brown; dorsal blue, margin with two pink-salmon lines and included space, then blue green.

Color in spirits: Anterior half of body to a line with sixth dorsal spine is pale pea-green; posterior to this line the color is darker, with a tint of bluish; a wide bright green line with narrow blue margins extends from posterior margin of opercle forward under eye, curving down under chin, the upper margin touching eye and the axis of mouth, this band lost on the pale green general color of the chin; anterior third of snout bright green, separated from darker color of upper part by a narrow navy-blue line; a more or less distinct dusky band from eye to posterior margin of opercle above the bright green line; a narrow margin of yellowish on upper lip; dorsal with a margin of bluish and a lighter submarginal line of grayish, the general color of fin green, with some purplish on posterior portion; outer two-thirds of anal pale green; inner third bluish-green crossed by two narrow lines of blue; pectoral greenish with purplish wash through center; ventral uniform pale green; caudal rather dark uniform green; iris golden; teeth white.

Four specimens from Pago Pago. The type is no. 51745, U. S. National Museum, length 13 inches.

1093. Callyodon kelloggii Jordan & Seale, new species. Samoa.

Head 3 in length; depth 2.75; eye 7.25 in head; snout 2.25; interorbital 2.75; dorsal ix, 10; anal iii, 9; scales 2-24-6; 3 rows on cheek, the lower row of one large scale covering anterior half of preopercular limb, and a minute scale anteriorly; lips broad, covering two-thirds or more of teeth.

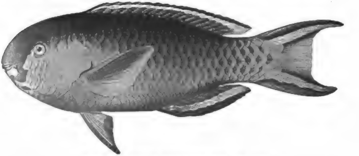


FIG. 62.—*Callyodon kelloggii* Jordan & Seale, new species. Type.

Body oblong, compressed; anterior profile bluntly rounded, the forehead being somewhat gibbous; depth of caudal peduncle 2 in head; teeth with posterior canine above and below; three rows of scales in front of dorsal, longest dorsal ray 2.50 in head, base of anal 1.30 in head, 2 in base of dorsal, the longest ray 2.75 in head; pectoral 1.10 in head; ventral 1.55 in head; caudal deeply lunate; exposed outer ray 1.25 in head, middle ray 3.25 in head. Color blue in life, with markings described below.

Color in spirits, dull olive-brown, top of head and an irregular line around chin livid green, a line of green on lower lip; a round green spot at end of lower limb of preopercle; a round green spot on isthmus with a green line just posterior to spot; a large yellowish area covering most of opercle and posterior part of cheek; a green line on lower half of orbit; three or four round green spots in front of anal; iris golden; teeth white; lower two-thirds of dorsal and a broad marginal line green, a rather wide submarginal line of yellowish white; the outer and the inner third of anal green, the middle third whitish, the white color taking its origin at base of third spine; pectoral unmarked, greenish; ventral broadly margined with green, the mid-portion being yellowish; caudal with upper and lower margins bright green with an intramarginal line of whitish which is bordered by very dark green; middle portion of caudal whitish with a wash of very pale green, no posterior marginal line or marking.

One specimen from Apia, type no. 51746, U. S. National Museum, length 11.50 inches. Named for Vernon Lyman Kellogg.

1094. Callyodon tricolor (Bleeker). Shortland I. (Seale); East Indies.

Scarus tricolor Bleeker, Verh. Bat. Gen., xxii, Labr. Cycl., 59, **East Indies.**

1095. Callyodon dussumieri (Cuvier & Valenciennes). Faté (Seale); East Indies.

Scarus dussumieri Cuvier & Valenciennes, Hist. Nat. Poiss., xiv, 252, 1839, **Seychelles.**
Pseudoscarus dussumieri, Bleeker, Atlas, i, Scaridæ, 46, tab. viii, fig. 1, Java.

1096. Callyodon pyrrhostethus (Richardson). Faté and Rarotonga (Seale); East Indies.

Scarus psittacus Forskål, Descr. Anim., 29, 1775, **Red Sea,** not *Scarus psittacus* L.
Scarus pyrrhostethus Richardson, Ich. Chin., 262, 1838, **Canton.**
Pseudoscarus pyrrhostethus, Günther, Cat., iv, 223.

1097. Callyodon pepo (Bennett). New Guinea (Macleay); East Indies.

Pseudoscarus cantori Bleeker.

1098. Callyodon fasciatus (Cuvier & Valenciennes). Faté (Seale); East Indies.

Scarus fasciatus Cuvier & Valenciennes, op. cit., 222, 1839, **Moluccas.**
Scarus rivulatus Cuvier & Valenciennes, op. cit., 223, 1839, **Java**; name preoccupied.
Scarus rivulatoides Bleeker, Verh. Bat. Gen., xxii, Labr. Cycl., 55, **East Indies.**
Scarus micrognathus Bleeker, op. cit., 56, **East Indies.**
Pseudoscarus rivulatus, Gunther, Cat., iv, 222, East Indies.

1099. Callyodon festivus (Cuvier & Valenciennes). Polynesia.

Scarus festivus Cuvier & Valenciennes, Hist. Nat. Poiss., xiv, 282, 1839, no locality.

1100. Callyodon frontalis (Cuvier & Valenciennes). Oualan.

Scarus frontalis Cuvier & Valenciennes, Hist. Nat. Poiss., xiv, 280, 1839, **Oualan (Caroline Is.).**

1101. Callyodon forsteri (Cuvier & Valenciennes). Tahiti.

Scarus forsteri Cuvier & Valenciennes, Hist. Nat. Poiss., xiv, 275, **Tahiti.**

1102. Callyodon prasiognathus (Cuvier & Valenciennes). *Amasapupema.* Samoa; New Ireland. (Pl. xlviii, fig. 2.)

Scarus prasiognathus Cuvier & Valenciennes, op. cit., 272, 1839, **New Ireland.**

We have 5 specimens of this fish from Pago Pago. It seems not to have been collected since the time of Quoy and Gaimard.

Head 3 in length; depth 2.85; eye 5.95 in head; snout 2.75; interorbital 3; dorsal ix, 10; anal iii, 9; scales 2–24–6, three rows on cheek, the lower row of two scales on lower limit of preopercle.

Body oblong, compressed; anterior profile rather sharp-pointed; depth of caudal peduncle 2.10 in head; no posterior canines; lips broad, covering more than two-thirds of jaws; 6 scales in front of dorsal fin; longest ray of dorsal 2.55 in head; base of anal 1.25, 2.10 in base of dorsal, its longest ray 3 in head; pectoral 1.30; ventral 1.80; caudal 1.40, the middle portion rounded, the rays very slightly produced.

Color in life, uniform very dark coppery brown; fins of same shade, much mottled; teeth deep blue.

Color in spirits, brown, a tint of bluish or violet on head; dorsal dark bluish with some blotches of gray on soft dorsal; pectoral purplish; ventral grayish, darker at tip; anal grayish, irregularly blotched with purplish; caudal purplish, darker at tip; margin of upper lip grayish; teeth green; iris golden.

The specimen described above is 7.50 inches long.

1103. Callyodon maoricus Jordan & Seale, new species. *Moalefuga.* (Pl. xlviii, fig. 3.)

Head 3 in length; depth 2.95; eye 5.95 in head; snout 2.20; interorbital 2.95; dorsal ix, 10; anal iii, 9; scales 2–24–6, three rows on cheek; lower row of 3 scales which almost cover the lower limb of preopercle.

Body oblong, compressed; anterior profile evenly rounded, the tip of head rather bluntly pointed; depth of caudal peduncle 2.30 in head; a single small posterior canine on upper jaw; upper lip wide, almost covering upper teeth, lower lip less wide, covering about two-thirds of lower teeth; base of dorsal fin 1.85 in length without caudal, its longest ray 2.95 in head; base of anal 1.30 in head, its longest ray 2.85 in head; caudal almost square, 1.75 in head; some specimens have outer rays prolonged; pectoral 1.14 in head; ventral 1.80 in head.

Life colors of one specimen, brilliant dark copper-red; lips and belly brighter; a bright blue-green stripe across upper jaw; two across lower, with 3 irregular green spots behind; dark green marks radiate from eye; a bright oblong spot of pale green above opercle; teeth deep blue; dorsal dark orange, dark shaded below and a broad edge of deep blue; caudal dark coppery, edged all around with bright blue, the stripe largest below; anal coppery red, with a very broad edge of deep blue; ventral coppery red, edged with blue; pectoral deep coppery red.

A large adult specimen was deeper in color and bluer than the type, but similar in all essentials: Teeth bluish; body deep reddish brown; upper lip brilliant green-blue with narrow pinkish margin; upper head smoky greenish brown, green-blue circumorbital ring, narrow; sides of head below eye paler, then irregular greenish longitudinal band; under head robin's-egg blue in front, paler behind with saffron-yellow, faint, ring-like blotches with small robin's-egg blue spot within; sides blue-green with broad pinkish brown basal edging on scales; dorsal with blue margin, saffron-pink median space with dark greenish blotches in series, weak to wanting anteriorly; ventral pale blue with bright blue anterior margin; pectoral smoky bluish, smokiest just before tips of rays; caudal green blue, bluer along dorsal and ventral margins, with uneven bluish pink at base and smoky clouds in web; anal like dorsal with the green blotches coalescent.

Color in spirits, dark brown, almost black; some specimens purplish, with a yellowish wash on belly, thorax, and under part of head, some specimens not lighter below; top of head green, tip of snout yellow; margin of lips yellow; a deep green line around upper third of upper lip; two green lines around lower lip, one near tip of lip, the other, which is margined with yellow, from lower part of orbit around base of lip, more or less united with green line running back on isthmus; a greenish black just in front of lower limb of preopercle, and a line of green dots along lower margin of lower limb of opercle; dorsal fin greenish; a wide, deep bluish green margin, with a sub-marginal area of yellowish; anal similar in color to dorsal; pectoral brownish with tint of blue; ventral yellowish with green margin, purple in some specimens; caudal bluish green, margin of deep bluish green; iris golden; teeth green; jaws well covered, deep blue; 3 rows of scales on cheek; a posterior canine. Caudal somewhat lunate.

Three specimens of this beautiful and strikingly marked species were secured at Pago Pago. It is called by the fishermen *Maolifuga* (Maori parrot-fish) because the green markings on the face suggest closely the paint on the face of a Maori chieftain. The species is near *Callyodon prasiognathus*, differing in the green marks on the head, and the deep blue edgings to the fins.

Type, no. 51747, U. S. National Museum, from Pago Pago, 10.25 inches long.

1104. Callyodon nuchipunctatus (Cuvier & Valenciennes). Fiji (Günther); New Guinea (Macleay).

1105. Callyodon latax Jordan & Seale, new species. *Laea pulepule; Laea mumu.* Samoa. (Pl. XLIX.)

Head 3.10 in length; depth 2.75; eye 7.50 in head; dorsal ix, 10; anal, iii, 10: snout 2.10 in head; scales 2–24–6; two rows of scales on cheeks; lower limb of preopercle bare.

Body oblong, compressed, the anterior profile evenly rounded; caudal peduncle strong, its depth 2.10 in the head; tubules of lateral line with several branches; a single small canine tooth on upper jaw at angle; lips thin, covering the basil third of the teeth; four rows of scales in front of the dorsal fin; longest dorsal spine 2.10, the longest ray of about equal length; base of anal 1.75 in head, 2.75 in base of dorsal, its longest ray 2.50 in head; pectoral 1.30 in head; ventral 1.50 in head; caudal lunate, the exposed outer ray 1.50 in head, exposed middle ray 3.50 in head.

Life colors, all clear deep blue, some scales on sides with brownish edges; jaws blue; lips blue; angles of mouth brownish red; head with slaty red markings about eyes and a band between them; dorsal slaty with blue base and edging and some spots; caudal blue with slaty blue markings; anal with slaty edgings and spots; ventral blue with olive center; pectoral blue with blackish slaty center.

Color in spirits uniform dull bluish green on body, a shade lighter below; the top of head and about eye is splashed with blotches, lines or dots of dull gray, irregular in form, and varying in different specimens. The short lines may either radiate from eye, or reticulate over head, or extend down the side of snout; either a line or row of dots at angle of jaws usually extending around under jaw; either a line or row of dots over the snout just in front of nostrils; no light colored line on upper jaw; teeth green; dorsal green, with oblique lines and margin of blue; anal similar in color to dorsal;

pectoral bluish without markings; ventral pale bluish green; caudal green with four or five irregular blue lines; iris golden.

Three large specimens of this fish were obtained at Apia. A specimen was taken at Rarotonga by Mr. Seale. It is a handsome and showy species.

The type is no. 51755, U. S. National Museum, and is 15 inches long, from Apia.

1106. Callyodon celebicus (Bleeker). Guam; East Indies.

Scarus celebicus Bleeker, Celebes, v, 253, **Celebes.** Seale, Bishop Museum 1901, 95, Guam.
Pseudoscarus celebicus Bleeker, Atlas Ichth., I, 26, tab. XV, fig. 2, Celebes. Günther, Cat. IV, 237, Sea of China.

1107. Callyodon cyanogrammus Jordan & Seale, new species. Samoa.

Head 2.75 in length; depth 2.75; eye 7.95 in head; snout 2.15 in head; interorbital 2.95; dorsal IX, 10; anal III, 9; scales 2–24–6, two rows on cheek; lower limb of preopercle bare.

Body oblong, compressed, the upper profile from origin of dorsal to middle of snout almost straight; from this point to base of lower jaw the profile is bluntly rounded; a single small posterior canine on upper jaw; upper lip broad, covering two-thirds or more of upper teeth, lower jaw narrow, covering less than half of lower teeth; depth of caudal peduncle 2.50 in head; three scales in front of dorsal fin; longest ray of dorsal about 3 in head; base of anal 1.50; 2.20 in base of soft dorsal, its longest ray about 3 in head; pectoral 1.35; ventral 2, its origin slightly posterior of a line with pectoral and dorsal; caudal very slightly emarginate, longest exposed ray 2 in head; exposed middle ray 3.50.

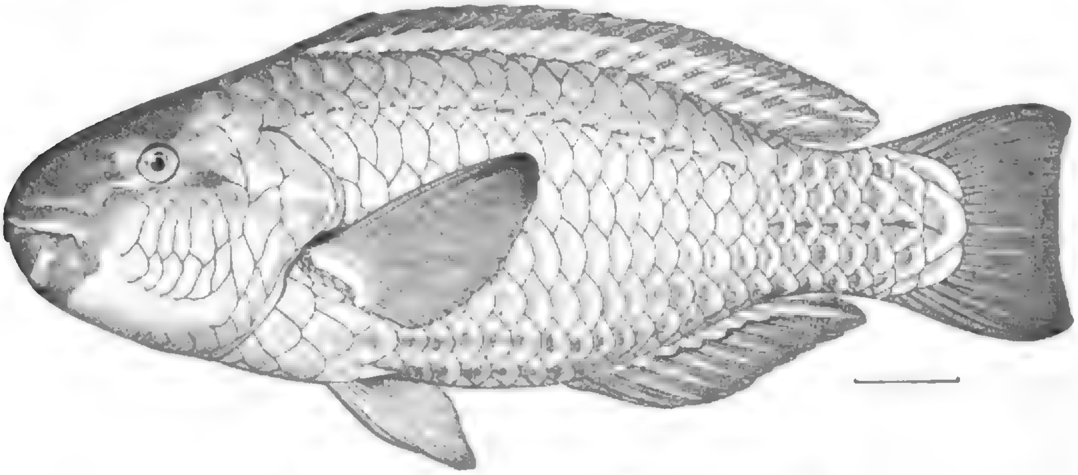


FIG. 63.—*Callyodon cyanogrammus* Jordan & Seale, new species. Type.

Color in life, green, brownish green on back, washed with golden behind middle of pectoral, the region midway between middle of anal and dorsal being distinctly bright yellow; scales above brown edged, those below edged with pinkish; head dark brownish above, the sides mostly bright greenish blue; belly light clear blue, as is caudal peduncle; cheeks golden washed; three green stripes, with purplish drab behind eye; lips blue, green behind and whitish in front; side of belly with four bright-blue stripes, one median, the interspaces of bright pinkish brown, which might be described as three pale brownish red stripes through the blue; dorsal deep gray-blue in the distal half, the rays brownish; the proximal half light greenish white, with a median green shade most distinct behind; caudal clear blue with some brassy shades; anal clear green, bright blue at edge, with a stripe made of greenish white spots at base; ventral blue green, deeper and bluer on edge; pectoral greenish blue, its upper distal third a diffuse blackish blotch, the breast at its base deep blue; teeth and jaws blue.

Color in spirits, back light brown, sides dull yellowish green; lower part of belly through sides and caudal peduncle pale green; three rather distinct greenish longitudinal lines on sides of belly; top of head, including nuchal region and snout, purplish; margin of lips yellowish; iris golden; teeth green; a green line with darker margins extending around lips posterior to yellow margins, these lines uniting at angle and extending back through lower part of orbit across the cheek to posterior margin of opercle; a short, indistinct green line through upper part of orbit extending back to upper margin of opercle; upper third of dorsal green, the color broadening and extending to base of fin anteriorly; lower two-thirds of fin yellowish with a more or less distinct greenish central area which broadens posteriorly and anteriorly is represented by dusky blotches on webs; anal livid green, a narrow yellow line at base which extends out to tip of seventh anal ray; pectoral greenish, the tip purplish; ventral uniform pale green; caudal uniform dark green.

This species is represented by one specimen from Apia, the type, no. 51756, U. S. National Museum, length 10.50 inches.

1108. Callyodon cypho Seale. Guam.

Scarus cypho Seale, Bishop Museum 1901, 95, **Guam.**

Head 3 in length; depth 3.20; interorbital 3.50; dorsal ix, 10; anal iii, 9; pectoral 14; scales 2–24–6, lateral line interrupted, the tubes branched; two rows of scales on cheek, with five scales in lower row, preopercular limb bare; pharyngeal teeth pavement-like, about twice as long as wide, the anterior ones the longest; teeth quite projecting, their length equal to orbit, two posterior canines at angle of upper jaw.

Body oblong, compressed, the upper profile of back quite convex; snout much produced; lips narrow, scarcely covering one-half of jaws; caudal lunate; pectoral 1.33 in head, its base 5, their shortest ray 4; ventral 1.50; base of anal 1.50, 2.83 in base of dorsal; 4 scales in front of dorsal, and 4 behind, its base convex, its posterior rays longest, 3 in head.

Color in spirits a uniform light green, a darker blotch extending over top of head and upper part of opercles; teeth greenish at base with white margin; lips a brighter green with a wash of yellowish, a narrow black line near their margins; fins greenish, dorsal with narrow intramarginal line of black, anal with a broad edge of brighter green, a narrow black line through its outer third, inner two-thirds white with wash of green; ventrals white with slight greenish wash; caudal green, lighter in center, with a dusky intramarginal line.

In spirits the coloring is similar to *Callyodon bataviensis.* The type, no. 160, Bishop Museum, is 9.5 inches long, from Guam.

1109. Callyodon troscheli (Bleeker). Laysan; East Indies.

Scarus troscheli Bleeker, Batavia, 408, **Java.**

Pseudoscarus troscheli Bleeker, Atlas Ichth., i, 25, tab. vii, fig. 2, Java. Steindachner, Denks. Ak. Wiss. Wien, lxx, 1900, 508, Laysan.

1110. Callyodon macleayi Jordan & Seale; new name. New Guinea.

Pseudoscarus frontalis Macleay, Proc. Linn. Soc. N. S. W. 1883, 590, not of Cuvier & Valenciennes.

1111. Callyodon gymnognathos (Bleeker). New Guinea (Macleay).

1112. Callyodon jordani (Jenkins). *Galo; Laea galo.* Hawaii; Samoa.

Pseudoscarus jordani Jenkins, Bull. U. S. Fish Comm., xix, 1899 (1900), 63, fig. 21, **Honolulu.**

We have 1 fine specimen of this large and brilliant parrot-fish, 20 inches long, from Apia. The species is highly valued at Honolulu by the natives, who eat it raw. A color drawing of the specimen from Apia is published in Jordan & Evermann's report on the fishes of Hawaii.

Head 2.85 to end of vertebræ, depth 3.75, eye 8.75 in head; snout 2.25 in head; interorbital 2.85; dorsal ix, 10; anal iii, 9; scales 2–24–6, 3 rows on cheek, the lower row of 3 scales on lower limb of preopercle.

Body oblong, compressed, anterior profile bluntly pointed, the snout in front of eye being gibbous; depth of caudal peduncle 2.80 in head; a distinct upper posterior canine; lips rather narrow, covering about one-half of upper jaw and one-third of lower, 6 rows of scales in front of dorsal; longest ray of dorsal 3.90 in head; base of anal 1.75, 2.75 in base of dorsal, its longest ray 3 in head; pectoral 1.50; ventral 1.90; caudal deeply lunate, the upper and lower rays prolonged.

Color in life, green, bright, clear, on back and posteriorly, belly and head bright blue, the belly pale; nape and shoulder region with a deep wash of purplish brown; cheek and opercle washed with golden; lips very blue, each with a pale creamy red band, sky-blue clouds on throat; iris golden; a pale drab streak before eye; dorsal with blue spines and rays, and a deep blue margin verging on black anteriorly; the color of the spines and rays varying with that of the body, blue, then purplish, and posteriorly green; orange ground-color of the membrane growing brighter behind and encroaching on the green, so that the last rays are green at base and blue at margin; caudal purplish brown toward the bluish base, then green, blue, and finally light orange on the edge; the lobes and upper and lower margins deep blue; anal dull orange, blue-shaded at base, the distal half bright blue; ventral greenish blue, the membranes mostly orange; pectoral greenish blue, the edge faintly orange.

Color in spirits, dull yellowish, shading into green anteriorly; a slight wash of purplish on head and nuchal region; two green bands around lower lip, the anterior one forming the margin, the posterior one uniting more or less with green coloring on isthmus; margin of upper lip yellow; an irregular green line from orbit to angle of jaws, and two or three indistinct green lines on cheek; a dark blotch back of eye, and on posterior lobe of opercle; posteriorly the scales of body have a slight wash of greenish on margin; spinous dorsal greenish, with darker margin; soft dorsal yellow, except its lower anterior third which is greenish; anal broadly margined with green, inner part of fin grayish, with some greenish blotches; pectoral green, with yellowish posterior margin; ventral green, their mid-portion yellowish; caudal green with some darker blotches, the margin yellowish; iris golden; teeth green.

1113. Callyodon strongylocephalus (Bleeker). Tahiti (Seale); Java.

Scarus strongylocephalus Bleeker, Java, II, 439. **Java.**

1114. Callyodon microrhinos (Bleeker). Fiji (Günther); New Guinea (Macleay).

1115. Callyodon ultramarinus Jordan & Seale, new species. *Fugu galu-moana.* Samoa.

Head 2.80 in length; depth 2.75; eye 8 in head; snout 2.20; interorbital 3; dorsal IX, 10; anal III, 9; scales 2-24-6, three rows on cheek, the lower row of 7 unjoined scales on lower limb of preopercle.

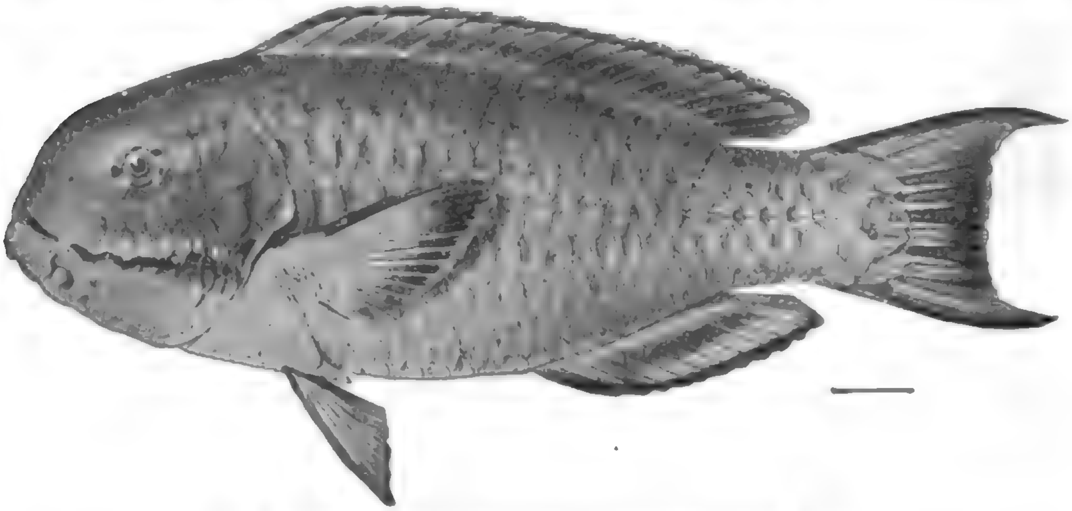


Fig. 61.—*Callyodon ultramarinus* Jordan & Seale, new species. Type.

Body oblong, compressed, anterior of head not evenly rounded because of the strongly gibbous forehead; depth of caudal peduncle 2.25 in head; three rows of scales in front of dorsal; two small blunt posterior canines in upper jaw, none in lower; lips narrow, not covering one-half of teeth in either jaw; base of dorsal fin 1.75 in length without caudal, its longest ray 2.40 in head; base of anal 1.50, 2.35 in base of dorsal, its rays longer than rays of dorsal, the longest ray 2.75 in head; pectoral 1.25; ventral 1.90; caudal lunate, exposed outer ray 1.75, exposed inner ray, 2.95.

Life colors of one specimen were dark greenish blue, rather abruptly slaty blue below, the two colors separated by a broad irregular blackish area which passes below the eye and around the snout; head-pad violet-blue; lips and throat brilliant blue green; a stripe of same back to base of pectoral, then upward along opercular edge, caudal peduncle clear blue green, dorsal dull olive, with a bright blue margin; caudal violet with blue spots on margin and posterior edge; anal light blue violaceous, edged with deep blue; ventral bluish, edged with bright blue; breast light blue; pectoral light blue with a median violet band, iris orange; no red or orange or yellow.

Another specimen, from Apia, was clear bluish green, of the same shade everywhere above the pectoral; each scale with a brown base and edge; lower parts of a clear crockery blue, less shaded with brown; head olive-green above, clear bright brown on the sides, golden olive on throat; lower lip orange, then a broad blue stripe, a narrow orange and a narrower blue one separating from the olive of throat; breast and median line of throat blue; upper lip blue with a narrow orange edge; dorsal dull orange, its margin bright blue; a series of large green spots mesially; caudal bright blue, an orange-brown streak in each lobe, brown shades at base; anal dull dark orange, its edge bright blue with a broad greenish blue median stripe; pectoral blue, with a longitudinal stripe of brown; ventral pale blue, with a bright blue edge; iris blue with a golden ring within.

A specimen from Pago Pago was brassy green, livid bluish below and more bluish on caudal peduncle, head more smoky; each body scale with reddish brown edge; dark green streaks radiating from eye; upper lip deep blue, margined with reddish; lower lip blue, with reddish edge and a yellow cross-band from angle of mouth; an angular blue green band from angle of mouth to gill opening far below eye; axil dusky; dorsal smoky orange, edged with blue, a median blackish stripe posteriorly; caudal bright blue, darker on margin and edge; anal blue washed with orange, with blue margin and a median stripe; pectoral blue, with blackish submarginal band; ventral robin's-egg blue, with bluer margin.

Another specimen from Pago Pago was very rich dark Nile green, with dark purplish brown scale-edgings, behind eye dark green linear blotches, and farther back a single light gold-green oblong blotch, edged with blackish; teeth blue; upper lip broadly scarlet, then green, then narrowly scarlet, then merging into fuliginous; lower lip narrowly margined with scarlet, then bluish green, then smoky lilac, then bluish green, then smoky lilac; ventrals lilac, with navy-blue anterior margin and sky-blue posterior margins; pectoral dark lilac-purplish, with bluer margins; anal with bright sky-blue margin and pinkish submarginal line merging into greenish; dorsal like anal; caudal with very light blue margin and mixed greenish bluish and thin yellowish green in middle; dorsal and ventral margins sky-blue, with pinkish salmon inside.

Color in spirits dull green with a wash of bluish, darker above, somewhat purplish on top of head; lighter below, shading into a pale green on under part of head, thorax, and belly; the very narrow margin of lips yellowish, the upper lip with a single dark bluish green band above the yellow margin, and with a narrow yellowish area above the blue line; a rather wide and very distinct bluish green line extends around under the jaw from which two other lines also extend around under the jaw, all the bands uniting near angle of mouth and extending back across the cheeks to posterior margin of opercles, on a line with upper base of pectorals; about 5 very short purplish lines radiate from eye; a lighter blotch at base of caudal; dorsal fin margined with deep blue, the spinous portion of fin pale green, the soft portion more or less blotched with purplish, the color assuming a rather wide band-like form in middle of fin; anterior, posterior, and outer margins of anal fin deep blue, an incomplete blue line at base, body of fin dull grayish, with wide blue band through center; pectorals greenish, the upper margin deep blue, the posterior margin gray with intramarginal dusky area; ventral pale green with first and second rays blue; caudal with upper and lower margins blue; the distal end of fin broadly margined with purplish about two irregular purplish bands near base; iris golden; teeth green.

Of this fish we have 7 specimens, all large, from Apia and Pago Pago. One from Apia, a very large example 2½ feet long, has the fleshy pad on the forehead highly developed. A specimen similar to this was taken by Mr. Seale at Mangareva. The type is no. 51757, U. S. National Museum, 13 inches long, from Pago Pago.

1116. Callyodon lazulinus Jordan & Seale, new species. *Fugausi.* Samoa.

Head 2.85 in length; depth 2.85; eye 7.50 in head; dorsal IX, 10; anal III, 9; scales 2-24-6; three rows of scales on cheeks, the lower row of four scales covering lower limb of preopercle.

Body oblong, compressed; anterior of head bluntly rounded; the snout slightly gibbous; depth of caudal peduncle 2.20 in head; no posterior canines; lips rather wide, covering slightly more than one-half of teeth; five scales in front of dorsal; base of dorsal 1.90 in length without caudal, its longest ray 3 in head; base of anal 1.50 in head, 2.10 in base of dorsal; pectoral 1.20 in head; ventral 2 in head; caudal deeply lunate, the upper and lower rays much prolonged, the upper slightly the longest, 1.10 in head.

Life colors of a specimen from Apia, deep blue-green, the head above and shoulders indigo; not much brown shade on scales; upper lip, stripe below eye, and streaks about eye clear blue-green; a red stripe on upper lip; lower with two of reddish brown, two of clear blue; breast and lower parts clear blue; dorsal blue in front and on edge, green at base behind; a median band of deep reddish brown; caudal deeply lunate, blue-green with a band of deep brown on each lobe; anal purplish blue at base, then a clear blue line, then bluish green, blue at tip; ventral purplish blue behind, greenish blue in front; pectoral clear green above, blue below, with a blue-brown dark stripe between; teeth blue.

A young example from Pago Pago had the iris white; above eye black-green; below eye green-blue; sides green-blue with brown-maroon scale markings; pectoral with longitudinal median blackish blotch and very bright anterior edge; ventral robin's-egg blue on anterior margin, salmon tinge within; anal bright green blue with pink-salmon basal band; dorsal green-blue with pink-salmon median band; caudal green-blue with pink-salmon blotches; green black stripe through eye and snout forming patch on opercle and one behind eye; teeth sky-blue; upper lip green-blue with maroon margin; lower lip with broad salmon-maroon bar behind margin and pinkish irregular blotch farther back.

Color in spirits pea-green, top of head and shoulders back to sixth dorsal spine and to a line with eye dark bluish green, with shading of purplish; this color separated very distinctly on line with eye from the pea-green of lower half of head; a short pea-green line through upper part of eye; tip of snout and lips pea-green, with an indistinct but slightly darker greenish line around upper lip, and two similar but broad lines on lower lip, the posterior one zigzaging down from eye to anterior margin of isthmus; a bluish spot on isthmus; dorsal greenish with a darker submarginal line, lower part of fin with an indistinct dusky line at base anteriorly and some dusky blotches posteriorly; outer two-thirds of anal yellowish green, the inner third pea-green, this pea-green area margined by narrow line of dusky; pectoral markings conspicuous, the upper four rays being olive-green, the middle portion purplish, the margin gray; ventral uniform greenish; caudal with outer rays bright green, the sublateral rays grayish, the middle of fin bright green; the distal margin is grayish; iris golden; teeth very dark green, almost dusky.

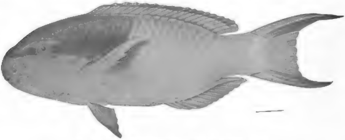


FIG. 65.—*Callyodon lazulinus* Jordan & Seale, new species. Type.

Fifteen specimens from Apia and Pago Pago. The type is no. 51758, U. S. National Museum, from Apia, length 12.90 inches.

1117. Callyodon cyanognathus (Bleeker). Faté and Shortland I. (Seale); East Indies.

Scarus cyanognathus Bleeker, Verh. Bat. Gen., XXII, 62, **Java.**
Pseudoscarus cyanognathus, Günther, Cat., IV, 234, Java.

1118. Callyodon mertensii (Cuvier & Valenciennes). Ulea.

Scarus mertensii Cuvier & Valenciennes, Hist. Nat. Poiss., XIV, 281, 1839. **Ulea.**

1119. Callyodon spilurus (Cuvier & Valenciennes).

Scarus spilurus Cuvier & Valenciennes, op. cit., 279, 1839. **Caroline Is.**

Family ANTIGONIIDÆ.

ANTIGONIA Lowe.

1120. Antigonia steindachneri Jordan & Evermann. Hawaii; Japan.

1121. Antigonia eos Gilbert. Hawaii.

Family EPHIPPIDÆ.

EPHIPPUS Cuvier.

Ephippus Cuvier, Règne Annual, ed. 1, 335, 1817 (*argus*).

Scatophagus Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 136 (*argus*).

Cacodoxus Cantor, Malay. Fish., 163, 1850 (*argus:* substitute for *Scatophagus* on account of the earlier genus *Scatophaga*).

1122. Ephippus argus (Gmelin). New Guinea (Macleay); New Britain (Peters, Berl. Mon., 1876, 833).

1123. Ephippus multifasciatus (Richardson). New Guinea; East Indies.

Scatophagus multifasciatus Alleyne & Macleay, Proc. Linn. Soc. N. S. W., 1883, 277, **New Guinea.**

DREPANE Cuvier & Valenciennes.

Drepane Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 129, 1831 (*punctata*).

Harpochirus Cantor, Malay. Fish., 162, 1850 (*punctata*); substitute for *Drepane*, there being genera of prior date, *Drepana*, *Drepanis*, *Drepanus*, and *Drepania*.

Cryptosmilia Cope, Trans. Am. Phil. Soc. 1867, 401 (*luna*).

1124. Drepane punctata (Gmelin). Samoa (Günther); New Ireland (Peters); East Indies.

PLATAX Cuvier.

1125. Platax orbicularis (Forskål). *Pe'ape'a uli.* Samoa; Tahiti; Papua; Fiji; New Ireland; Shortland I. (Seale); East Indies.

Chætodon orbicularis Forskål, Descr. Anim., 59, 1775, **Red Sea.**

Platax orbicularis, Günther, Fische der Südsee, 140, Tahiti. Klunzinger, Fische Rothen Meeres, 118, Red Sea; with good diagnosis of the two species.

Chætodon vespertilio Bloch, Ichth., 67, taf. 199, fig. 2, 1787, **East Indies.**

Platax vespertilio, Bleeker, Atlas, Chæt., 74, tab. XVII, fig. 1, tab. XVIII, figs. 2 and 3, Sumatra, New Guinea, and all other East Indian islands. Peters, Berl. Mon., 1876, 836, New Ireland.

Chætodon pentacanthus Lacépède, Hist. Nat. Poiss., IV, 454, 471, tab. 11, fig. 2, 1803, **Pacific Ocean.**

Platax albipunctatus Rüppell, Atlas, 69, taf. 18, fig. 4, 1828, **Red Sea.**

Platax ehrenbergi Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 221, 1831, **Red Sea.**

Platax guttulatus Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 227, pl. 186, fig. 1, 1831, **Ile de France.**

This fish, widely distributed throughout the East Indies, is rather common about Samoa. We have three specimens taken in the seine at Pago Pago and two from Apia.

The species is distinguished from the next by the fact that the middle cusp of each tooth is longer than the others. The scales are considerably larger than in *Platax teira*, and the anterior profile is a little less vertical. The color is similar in the two species, the cross-bands disappearing with age.

A specimen from Apia was olive-gray, with blackish on the fins; no bright colors. A young example from Pago Pago was blackish in life, with a diffused blackish ocular band; breast soiled yellowish; base of pectoral with a large black spot; caudal abruptly whitish; ventral black; dorsal V, 37; scales 63.

1126. Platax teira (Forskal). Palau Is; New Guinea; East Indies.

Chætodon teira Forskål, Descr. Anim., 60, 1775, **Red Sea.**

Platax teira, Günther, Fische der Südsee, 141, 1876, Palau Is. Bleeker, Atlas, Chæt., 73, tab. XVII, fig. 2, tab. XX, fig. 1; Sumatra, New Guinea, Borneo, and all the East Indian islands. Klunzinger, Fische Roth. Meeres, 119, Red Sea. Jordan & Fowler, Proc. U. S. Nat. Mus., XXV, 1903, 526, Formosa, Riukiu Is., Tokyo, Kagoshima, Bonin Is., Kezen.

Chætodon arthriticus Bell, Philos. Trans. 793, 8, pl. 6, **Sumatra.**

Platax gaimardi Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 216, 1831, **New Guinea.**
Platax borsi Bleeker, Derde Bijdr. Celebes, 758, 1852, **Celebes.**
Platax xanthopus Bleeker, Verh. Bat. Gen., XXIII, 28, 1850, **Sumatra.**

This species, known by the smaller scales, is common in the East Indies and northward to southern Japan. It is recorded by Günther from the Palau Islands.

1127. Platax pinnatus Bleeker. New Guinea (Macleay).

Family CHÆTODONTIDÆ.

FORCIPIGER Jordan & McGregor.

Forcipiger Jordan & McGregor in Jordan & Evermann, Bull. 47 U. S. Nat. Mus., 1898, 1671 (*longirostris*).

This genus differs from *Chelmon* Cuvier in the long and high spinous dorsal, which is composed of 12 stout spines (9 in *Chelmon*). The snout, as in *Chelmon*, is very long and slender, bearing the short, forcep-like jaws at the end. From *Prognathodes*, a genus still more closely related, *Forcipiger* differs in the small scales, there being about 75 in a horizontal series.

1128. Forcipiger longirostris (Broussonet). Hawaii; Samoa; Tahiti; Paumotu Is.; Kingsmill I.; Tonga; Raiatea (Seale); East Indies; Clarion Is. (as *Forcipiger flavissimus* Jordan & McGregor).

This curious and brightly colored fish ranges widely through the South Seas and eastward to the off-shore islands of Mexico. It seems to be nowhere common, and but one specimen was found by us at Pago Pago. A few specimens were taken also at Honolulu.

Color in life bright yellow, from a line connecting front of dorsal with axil of pectoral and a point behind ventrals; scales of side shaded with orange; top of snout to nape and opercular region jet black; lower parts of head and breast abruptly black; dorsal, anal, ventral, and pectoral yellow; a large black spot on last rays of anal; caudal grayish.

A specimen from Pago Pago was in life brilliant yellow, deeper and orange-shaded behind, a black triangle on head, livid white below; ventral and pectoral yellow; caudal colorless; a large jet black spot on anal.

MEGAPROTODON Guichenot.

Megaprotodon Guichenot, Rev. Zool., 1848, 12 (*bifascialis*).
Eteira Kaup, Arch. Nat., XXVI, 1860, 147 (*triangularis*).

This genus is characterized by the constant presence of four anal spines. It is close to the group called *Linophora* in *Chætodon*, having the series of scales meeting at right angles. The body is oblong and compressed, the soft dorsal and anal produced and concave on the margin. Outer teeth of lower jaw a little longer than inner. The genus or subgenus *Gonochætodon* is near *Megaprotodon*, but it has the body almost as deep as long, as in *Coradion*.

1129. Megaprotodon trifascialis (Quoy & Gaimard). *Mutu uli.* Samoa; Guam; Tahiti; East Indies. (Pl. L, fig. 1.)

Chætodon trifascialis Quoy & Gaimard, Voy. Uranie, II, 379, pl. 62, fig. 5, 1824, **Guam, Batu.** Young with the caudal pale instead of black as in the adult.
Chætodon triangularis Rüppell, Atlas, 42, pl. 9, fig. 3, 1828, **Red Sea.**
Megaprotodon triangularis, Seale, Bishop Museum 1901, 101, Guam.
Chætodon strigangulus Solander, in Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 42, 1831, **Tahiti.** Günther, Fische der Südsee, 35, pl. 26, fig. A, Polynesia.
Megaprotodon strigangulus, Bleeker, Atlas. Chæt., 54, tab. XIII, fig. 4, Java, Batu, Celebes, Halmahera, Ceram Banda, Amboina, Timor, Obi-major.
Chætodon bifascialis Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 48, 1831, **Guam.**
Chætodon leachi Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 49, 1831, no locality.

This species, generally common throughout the East Indies, is abundant about the coral reefs of Samoa. The young closely resemble the adult in form and general color, but differ in the markings posteriorly. A broad dark band includes the soft dorsal and anal. This grows narrower with age, and finally vanishes. In the young the caudal is yellow with a narrow dark cross-band. In the adult it is black, with a narrow pale band near its tip. The nominal species *trifascialis* is the young of the one called *triangularis* or *strigangulus*. The name *trifascialis* has priority.

Fifteen specimens from Apia and Pago Pago. One from Apia was in life gray, white below, V-shaped stripes, bright grayish blue, the angle toward the head; ocular band broad, edged with white and golden; snout and forehead gray, with orange marks about jaws; two oblong whitish clouds on side just above level of eye, the one ending near end of pectoral, the other at base of soft dorsal; dorsal orange, dusky behind on base of soft dorsal, edged with orange, black and white; caudal black, edged above and below with orange-yellow; a golden yellow cross-band, a black, then a drab edge; anal creamy orange, edged with black and white; ventral yellowish white; pectoral colorless, orange-yellow at base.

Small specimens have the tail yellow, not black as in the adult; a broad black band involving soft dorsal and anal and the space between.

GONOCHÆTODON Bleeker.

Body very deep; dorsal and anal fins nearly vertical posteriorly. Sides with vertical streaks, meeting at an angle along the axis, the angle pointing forward.

1130. Gonochætodon triangulum Cuvier & Valenciennes. New Guinea (Macleay); East Indies.

(*Chætodon triangulum*, *baronessa*, and *karraf*, Cuvier & Valenciennes.)

CHÆTODON (Artedi) Linnæus. *Tifitifi*.

ANALYSIS OF POLYNESIAN SPECIES OF CHÆTODON.

a. LINOPHORA: Rows of scales of anterior part of body running upward and backward, each marked by a dark line, those of posterior part of body running downward and backward almost at right angles with the first; snout acute.

b. Dorsal fin with the first soft ray prolonged into a whip; a black ocellus below it; ocular band broad; ventral pale; two black lines across caudal.

c. Dorsal fin with a black ocellus below the prolonged ray........*setifer*

cc. Dorsal fin without black ocellus........*auriga*

bb. Dorsal fin without produced ray; no black ocellus; ocular band broad, white-edged; a broad black band across base of dorsal to middle of base of anal; two black bands on caudal; ventral pale........*vagabundus*

aa. Scales not arranged as above indicated, or at least not marked by lines meeting at an angle.

d. Scales large, arranged in rows which are very distinct, both upward and backward and downward and backward, forming a checker-board appearance; scales on middle of body very large.

e. Ocular band very broad below; a black band on soft dorsal; a broad, black band on caudal; ventral pale; snout sharp........*rafflesi*

ee. Ocular band not broader than eye; a short black nuchal bar; dorsal and anal narrowly edged with dark; caudal with a dark line; ventral yellow........*xanthurus*

dd. Scales not arranged as above indicated.

f. Scales unequal, those on middle parts of body larger than the others, the series usually extending upward and backward, at least posteriorly; teeth very small.

g. CHÆTODONTOPS: Snout acute, concave in upper profile.

h. Ocular band mesially yellow, with dark edges.

i. Body with 7 oblique dark stripes running upward and backward; caudal with a black crossbar; ventral pale........*pelewensis*

hh. Ocular band black.

j. Ocular band broad, as broad as eye.

k. Body with two dark violaceous cross-bands coalescent above, with narrow vertical streaks between them; caudal peduncle with a jet-black spot; a black line across caudal; ventral pale....*ulietensis*

kk. Body without black cross-bands.

l. Black area at base of soft dorsal broad, sending oblique streaks downward and forward across the body; no black area on shoulder; ventral pale........*lineolatus*

ll. Black area at base of soft dorsal narrow, the oblique cross-streaks along rows of scales orange; shoulder region black, with a median triangular orange area on each side; ventral pale..*lunula*

jj. Ocular band faint or narrow, not so broad as eye.

m. Ocular band obscure; a black band from soft dorsal across to anal; caudal with a black bar; ventral dark........*flavirostris*

mm. Ocular band distinct, narrower than eye.

n. Body with numerous V-shaped cross-bands, the angle toward the head; a broad yellow band across soft dorsal to anal; ventral dark........*mertensi*

nn. Body with about six dark, curved cross-bands, each scale posteriorly with a black spot; back with a dark shade; fins mostly yellow........*dixoni*

nnn. Back blackish; side with oblique dusky lines; a black spot at base of anal spines; a black spot on breast, and two on base of caudal peduncle; a pale blotch on side of back; ventral pale; entire contour of body yellow........*melannotus*

gg. Snout obtuse, the profile not concave, ocular band very broad, extending from the nape to the ventral, edged on both sides with yellow; snout black; body dusky, dove-colored above, each scale with a yellowish spot; anal and band across caudal peduncle black; tips of last rays of anal fiery red; two black lines across caudal........*reticulatus* *ff.* LEPIDOCHÆTODON: Scales unequal, those of the middle part of the body above largest; teeth much larger than in related species; rows of scales nearly horizontal; snout moderate; the profile projecting above eye.

o. Side of back with a large black ocellus, often produced downward in a wedge-shaped blotch; ocular band broad, meeting its fellow on breast; a black band on margin of dorsal and anal across caudal peduncle; ventral pale; caudal plain .... *unimaculatus*

oo. Side of body with a black cross-blotch from last dorsal spines to above anal spines; ocular band broad below; ventral black; caudal plain; teeth undescribed .... *trichrous*

ooo. Side of body from front of anal backward entirely blackish; a black bar from front of dorsal to ventral, which is black; ocular band broad................................. *kleini*

fff. RABDOPHORUS: Scales subequal, the series extending horizontally or slightly extending posteriorly; teeth small; snout obtuse or moderately acute.

p. Soft dorsal with its first ray produced and whip-like; snout acute.

q. Back with a large black saddle-shaped area covering most of the dorsal and edged with white below; ocular band very narrow and faint; ventral pale; caudal plain.. *ephippium*

qq. Body bright orange, with blue spots along the rows of scales; ocular band broad, distinct; base of dorsal and anal black; ventral pale; caudal plain................. *semeion*

pp. Soft dorsal without elongate or whip-like ray; snout obtuse or slightly acute, not convex above.

r. Body with about six transverse cross-bands; ocular band narrow, faint, a black spot above it; a reddish band on caudal peduncle; caudal with a black bar; ventral pale .... *punctatofasciatus*

rr. Body without dark cross-bands.

s. Body with about 10 narrow dark cross-streaks, each a row of small spots; ocular band narrow; a black bar across caudal peduncle; anal with a narrow dark edge; ventral pale.. .... *miliaris*

ss. Body with many oblique dark cross-streaks, each a series of spots along the row of scales, those above ascending, those below horizontal; no black on caudal peduncle; anal with a broad black streak and a bright yellow one above it; ocular band narrower than eye, sharply defined .... *citrinellus*

sss. Body without series of streaks, either oblique or vertical.

t. Ocular band present; snout obtuse.

u. Ocular band preceded by a black bar.

v. Black bar before eye covering snout; a black bar behind ocular band; body with dark streaks along rows of scales; a black area surrounded by golden on dorsal, anal and caudal; ventral pale; a black spot on breast....... *trifasciatus*

vv. Black bar before eye, not covering upper lip, which is pale; a black area above eye; three black bands behind eye, the first one extending backward to last ray of soft dorsal; body with 6 oblique orange stripes; caudal with two black stripes; anal with one; ventral pale .... *ornatissimus*

uu. Ocular band not preceded by a black bar.

w. Side of body with a black spot or ocellus; ocular band moderate, edged with blue; no black on fins.

x. Sides of body below with 2 or 3 blue streaks; lateral spot a rounded ocellus... *bennetti*

xx. Sides of body below with about 13 faint streaks; lateral spot large, oblong .... *speculum*

ww. Side of tail with a black ocellus; pale streaks along rows of scales; no black on fins; ocular band pale-edged.................................... *plebeius*

www. Side of body and tail without ocellus.

y. Back blackish, with two whitish blotches; ocular band orange, with dark edges; fins pale, with dark lines......................... *quadrimaculatus*

yy. Body with diffuse dark spots; ocular band broad, diffuse; snout black; ventral black; no yellow..................................... *corallicola*

tt. Ocular band none; body with about nine oblique stripes of clear blue; caudal peduncle and posterior part of dorsal black; caudal with a broad black band; ventral pale; snout rather acute .... *fremblyi*

1131. Chætodon setifer Forskål. *Si'u; Tifitifi sama.* Hawaii; Samoa; Johnston I.; Guam; Tubuai; Rarotonga and Faté (Seale); East Indies.

Chætodon setifer Bloch, Ichth., tab. 426, fig. 1, 1788, **Coromandel**. Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 77, Bolabola, Ile de France. Günther, Fische der Sudsee, 36, taf. 26, fig. B, Sandwich Is. Smith & Swain, Proc. U. S. Nat. Mus., V, 1882, 137, Johnston I. Seale, Bishop Museum, 1901, 96, Guam.

Tetragonopterus auriga Bleeker, Atlas, Chæt., 47, tab. XI, Sumatra, Java, and all islands of the East Indies; not *Chætodon auriga* of Forskål.

Chætodon auriga, Steindachner, Sitz. Ak. Wiss. Wien 1900, 488, Honolulu; not of Forskål.

This fish is common throughout the South Seas. We have 45 specimens from Apia and Pago Pago, where next to *Chætodon vagabundus* it is the most abundant of the *tifitifis*. It is known at once by the black ocellus on the dorsal, one of the rays of which is produced. The dorsal ocellus with other characters separates the species from the closely related *Chætodon auriga* of the southern coasts of Asia. The lines at right angles on the body are also characteristic. The name *tifitifi* is given to all chætodonts in Samoa, though primarily applied to *Zanclus canescens*. *Tifi* means angle; *tifitifi* the horns of the moon. The word corresponds to *kihikihi* of the Hawaiians.

Life colors of a Samoan specimen, anteriorly gray, posteriorly deep lemon-yellow, with opposing stripes of violet-gray; forehead gray, with deep orange-yellow cross streaks; ocular band broad, meeting its fellow below; soft dorsal edged with black, with a large black spot; a yellow streak on soft dorsal within the blackish edge; filament black before, yellow behind; caudal lemon-yellow; band light bright yellow, bordered before and behind with brown; tip of caudal translucent; anal gray at base, orange behind and outside, edged with a black line and yellow; pectoral and ventral clear gray.

1132. Chætodon auriga Forskål. Melanesia; East Indies.

Chætodon auriga Forskål, Descr. Anim., 60, 1775, **Red Sea.** Günther, Cat., II, 7, Red Sea.

This species of the Indian region is not certainly known from the islands of the Pacific.

1133. Chætodon vagabundus Linnæus. *Tifitifi mata-ume; Samasama.* Samoa; Vanicolo; Fiji; Faté; Shortland and Raiatea (Seale); East Indies.

Chætodon vagabundus Linnæus, Syst. Nat., I, 465, **Indies.** Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 50, 1831, Ile de France, Vanicolo, Amboina. Günther, Fische der Südsee, 43, everywhere in Polynesia.

Tetragonoptrus vagabundus, Bleeker, Atlas, Chæt., 48, tab. XVI, Sumatra, Java, Celebes, and all other islands of the East Indies.

This fish, abundant throughout Polynesia, is by far the most abundant species of the group at Samoa. Seventy specimens were taken at Apia and Pago Pago. The species is not one of the brightest in color. In the presence of narrow streaks meeting at right angles it resembles *Chætodon setifer*, but it has neither dorsal filament nor ocellus.

Life colors of one specimen, gray, olivaceous above, becoming golden behind; oblique streaks of purplish gray meeting at angles; ocular band broad, not pale-edged except below in front; forehead gray, with six orange cross-shades; first dorsal black, with a median yellow streak which widens to cover most of soft dorsal; a broad black margin to soft dorsal; a black bar at its base, edged before and behind with yellow, which crosses caudal peduncle, ending below on center of anal; anal otherwise dark yellow, grayish at base, with black and light yellow edge; spines very pale yellow; caudal golden yellow with a black crescent, a black crossbar behind it, and a colorless tip; ventral and pectoral pale.

This species seems obviously near *Chætodon setifer*, and lends some support to Bleeker's group *Linophora*.

1134. Chætodon xanthurus Bleeker. New Britain; East Indies.

Chætodon xanthurus Bleeker, Act. Soc. Ind. Ned. Amboina, 58, **Amboina.** De Vis, Proc. Linn. Soc. N. S. W. 1884, 457, Api, New Britain.

Tetragonopterus mertensi Bleeker, Atlas, Chæt., 50, tab. XVI, fig. 3, Amboina; not type.

1135. Chætodon rafflesi Bennett. Samoa; Palau; Fiji; Waigiu; Papua; New Hanover; East Indies.

Chætodon rafflesi Bennett, Life of Raffles, 689, 1830, **Sumatra.** Günther, Fische der Südsee, 44, taf. 35, fig. C., Melanesia, Palau, Fiji. Peters, Berl. Mon. 1876, 832, New Hanover.

Tetragonopterus rafflesi Bleeker, Atlas, Chæt., 49, tab. XIV, Sumatra, Java, Bawean, Celebes, Sumbawa, Timor, Halmahera, Ternate, Ceram, Amboina, Goram, Aru, Waigiu, New Guinea.

Chætodon princeps Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 33, 1831, **New Ireland.**

This pretty species is rare about Samoa, nine specimens in all being taken at Apia and Pago Pago. Günther's figure is fairly good, but the color is too pale, the fish being more olive in shade. The checker-like orange markings on the edges of the scales give a characteristic mosaic appearance.

Colors in life, deep yellow, greenish-tinged on body, very bright on fins; the body checkered with two sets of pinkish brown cross-streaks on edges of scales, these colors purplish on small scales at base of fin; snout brown; forehead gray; chin bright yellow; ocular band broad, whitish-edged only below in front; soft dorsal greenish on scales, then clear brown, then clear yellow, black and yellow; spines brownish, with greenish membranes; anal yellowish-green and purple-dotted on scales, then clear brown with two yellow bars on last rays and a yellow edge, with a black and white bounding line; caudal clear yellow with a black band, broadest in the middle, clear yellow behind, the edge clear gray; pectoral gray; ventral bright golden.

1136. Chætodon pelewensis Kner. *Tifitifi i'u sama* (orange-tailed). Palau Is.; Samoa; Tonga; Tahiti; Paumotu Is.; New Hebrides; Faté (Seale).

Chætodon pelewensis Kner, Sitz. Ak. Wiss. Wien 1868, 306, **Palau Is.** Günther, Fische der Südsee, 43, taf. 31, fig. B, Tonga, Palau, Samoa, Tahiti, Paumotu, New Hebrides.

Of this handsome little *Chætodon* we secured 6 specimens from Apia and Pago Pago. From most other species, *Chætodon pelewensis* is known by the yellow median stripe on the black ocular band.

Life colors of a specimen from Apia, yellow-olive, clear yellow behind, gray on sides; forehead black; ocular band yellow, edged on each side by black and gray; preorbital yellow; yellow on preopercle; dots and wavy bands purplish black; dorsal brown-olive, clearer behind, a broad golden edge set off by a black line; caudal peduncle clear bright orange, as in *Holacanthus* (*flavissimus*), then light yellow, then black, the fin mostly translucent; anal creamy brown, with a black streak above and below, the edge soiled greenish gray; ventral dusky; pectoral colorless; a black blotch on nape before dorsal.

1137. Chætodon ulietensis Cuvier & Valenciennes. Samoa; Paumotu; Tahiti; Guam; Kingsmill I.; Raiatea (Seale).

Chætodon ulietensis Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 39, 1831, **Ulietea.**

Chætodon falcula Günther, Fische der Südsee, 39, taf. 27; Paumotu, Tahiti, Harvey, Samoa, Kingsmill I.; not of Cuvier. Seale, Bishop Museum 1901, 101, Guam.

Of this fish we have 8 specimens from Apia and 4 from Pago Pago. It is well distinguished from the closely related *Chætodon falcula* of the East Indies, with which Bleeker and Günther have confounded it.

Colors in life, light gray or clear whitish, slightly brownish in front, bluish mesially, with two broad cross-bands of deep drab, the posterior deepening to black above, both fading below but evident below the level of the pectoral fin; above they extend on the dorsal fin, the anterior bar narrowed and sharply turned backward at base of spinous dorsal; the two cross-bands and the pale interspace marked by 15 or 16 narrow, sharp, nearly vertical lines of drab-black, like pencil marks, these corresponding to the rows of scales; area behind second lateral band clear golden-yellow on body and fins; ocular stripe broad, deep black, without edge; snout dusky above; an oblong vertical jet-black spot crossing narrowest part of caudal peduncle; spinous dorsal clear light yellow along edge; soft dorsal and anal golden yellow like the body; dorsal with two narrow brown streaks not parallel, then light yellow, brown, and finally a blackish edge; anal spines bright light yellow, the fins with three dark parallel streaks, two brown, one black, then a golden edge; caudal golden yellow, with a black curved cross-streak and a broad transparent edge; pectoral colorless; ventral soiled white; forehead with faint brownish yellow cross-streak. Another specimen with bands black rather than violet.

1138. Chætodon lineolatus Cuvier & Valenciennes. Hawaii; Samoa; New Hanover; New Guinea; Faté (Seale); East Indies.

Chætodon lineolatus Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 40, 1831, **Ile de France.** Quoy & Gaimard, Voyage de l'Astrolabe, 381, 1835, Ile de France. Günther, Fische der Südsee, Hawaii, Samoa, Tahiti, Kingsmill I. Steindachner, Sitz. Ak. Wiss. Wien 1900, 469; Honolulu.

Tetragonoptrus lineolatus, Bleeker, Atlas, Chæt., 51, tab. XV, Cocos, Sumbawa, Flores, Ternate, Amboina, Banda.

Chætodon lunatus (Ehrenberg) Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 57, 1831, Red Sea.

Chætodon oxycephalus Bleeker, Ternate, 9de Beidr., 608, **Ternate.** Peters, Berl. Mon. 1876, 232, New Hanover.

Chætodon tallii Bleeker, Banda, 3de Beidr., 97, **Banda.**

This large and handsome species is common at Honolulu and westward to the East Indies. It is recorded from Samoa, but we did not find it there.

1139. Chætodon lunula (Lacépède). *Tifitifi laumea.* Hawaii; Samoa; Papua; Oualan; Tahiti; Rarotonga; Nukahiva; Makatea and Tahiti (Seale).

Pomacentrus lunula Lacépède, Hist. Nat. Poiss., IV, 507, 1803, **Ile de France.**

Chætodon lunula, Cuvier & Valenciennes, Hist. Nat. Poiss., 59, pl. 173, 1831, **Ile de France**, Prince of Wales I., New Guinea, Australia. Günther, Fische der Sudsee, 42, Hawaii, Tahiti.

Chætodon biocellatus Cuvier & Valenciennes, Hist. Nat. Poiss., 62, **Oualan**; young.

Tetragonoptrus fasciatus, Bleeker, Atlas, Chæt., 44, tab. XII; not *Chætodon fasciatus* Forskål; Java, Bawean, Borneo, Celebes, Sangi, Timor, Halmahera, Buro, Amboina, Ceram, New Guinea.

This splendid species is rather common about Samoa, as at Honolulu. It has been confounded by Bleeker and others with *Chætodon fasciatus* Forskål of the Red Sea. The varied markings of the shoulders, with the broad white postocular band, are characteristic in the adult. The changes in the young are well figured by Dr. Günther.

We have 15 specimens from Apia and Pago Pago. One was colored in life as follows: Deep golden, a little olive-tinged and more dusky on back; chin gray; patch behind ocular stripe clear gray; oblique black band bordered before and behind by clear golden brown, a blackish blotch at first dorsal spine with golden brown behind it; spot on caudal peduncle and stripe on dorsal golden; a brown shade across dorsal and anal besides black tips and dark brown bands; ventral golden with some dusky; pectoral and edge of caudal colorless.

1140. Chætodon flavirostris Günther. Vavau; Tonga; Faté (Seale).

Chætodon flavirostris Günther, Fische der Südsee, 41, **Vavau (Friendly Is.)**.

1141. Chætodon mertensi Cuvier & Valenciennes. *Tifitifi pa'ipa'i.* Paumotu Is.; Samoa.

Chætodon mertensi Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 47, 1831; after a drawing by Mertens from a specimen from an unknown locality. Günther, Fische der Südsee, 45, taf. 36, fig. B, Paumotu.

Of this rare species, hitherto known only from the scanty original description and from the excellent figure given by Dr. Günther, we have four specimens from Apia and Pago Pago. This species is known by the presence of four distinct angular cross-bands, with some fainter ones. Behind these is a broad yellow cross-band involving most of the dorsal and anal.

The species (*Chætodon xanthurus*) called *Tetragonoptrus mertensi* by Bleeker is distinct from this species.

Colors of a specimen from Pago Pago, bluish gray; rich orange-yellow behind last dorsal spine, on body and dorsal and anal fins, including all of soft dorsal and most of anal; forehead and a scapular bar dark brown; ocular stripe broader above, where it is white-edged, the two not meeting below; five V-shaped blackish cross-bars on body behind shoulder, the angle toward the head; 4 rows of spots in concavity of last bar, between it and the immaculate golden area; first dorsal light yellow; second with edge of black and light yellow; anal dusky gray in front, edged with orange, posteriorly like dorsal; caudal light yellowish gray at base, then deep orange-yellow, edged with a fine line of black, then yellow; ventral soiled gray; pectorals plain.

1142. Chætodon dixoni Regan. New Hebrides.

Chætodon dixoni Regan, Ann. Mag. Nat. Hist., 1904, 276, **New Hebrides**.

1143. Chætodon melannotus Bloch & Schneider. *Tifitifi pulepule pa'ipa'i.* Samoa; Fiji; New Guinea (Macleay); East Indies.

Chætodon melannotus Bloch & Schneider, Syst. Ichth., 224, 1801, **Moluccas**. Günther, Fische der Südsee, 44, Samoa, Fiji Day, Fishes of India, 108, pl. 28, fig. 1, India. Steindachner, Ichth. Beitr., XVI, 230, 1893, Fiji.

Chætodon dorsalis Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 70, **Moluccas**; name preoccupied.

Chætodon marginatus (Ehrenberg) Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 57, **Massuah**: name preoccupied.

Chætodon abhortani Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 58, **Ile de France**.

Tetragonoptrus melanotus Bleeker, Atlas, Chæt., 43, tab. XIV, **Batu, Celebes, Flores, Timor, Ternate, Ceram, Amboina, Goram, Banda**.

This species is rather rare about Samoa, only seven specimens being taken at Apia and Pago Pago. The diffuse black spot at the base of the anal and the black spot at the throat are characteristic traits. Day has given a fair figure of the species.

Life colors of a specimen from Apia, gray, the contour all bright yellow; a broad, blackish patch occupying the whole back, this edged below by dull whitish; a large whitish blotch in the middle of the back; scales with dusky rows of diffuse blackish spots running upward and backward, these more streak-like above, the spots separate below, most distinct at base of anal, where they are gathered into an oblique jet-black spot of irregular outline; a black streak along lateral line posteriorly, widened into a jet-black blotch below last soft dorsal rays; a smaller black blotch above last ana' ray on edge of caudal peduncle; ocular band narrow, edged on both sides with bright yellow; region before it brownish yellow, clear yellow at throat, a dusky spot on breast; spinous dorsal deep brownish yellow; soft dorsal dusky, then yellow, then a broad blackish band with a black line above, then clear yellow, with a dusky edge: anal broadly clear yellow, with a brownish shade across it, then dusky, then a black line, then clear yellow; caudal bright yellow, with a narrow, dusky shade, then a blackish cross line, the posterior half translucent; pectoral colorless, light yellow at base; ventral golden yellow.

Another specimen from Apia had the lower half of side light bluish gray, above blackish with a pale area; margin all around yellow, golden below, orange above, with black markings, pectoral and also broad tip of caudal colorless.

1144. Chætodon reticulatus Cuvier & Valenciennes. *Matagi pulepule; Tifitifi a'au* Samoa; Tahiti; Ulea; Paumotu Is.; Rarotonga and Raiatea (Seale).

Chætodon reticulatus Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 32, **Tahiti, Ulea.**
Chætodon collaris Günther, Fische der Südsee 40, Paumotu; not of Bloch nor of Bleeker.
? *Chætodon bellicosus* Quoy & Gaimard, Voy. Astrolabe. 1835; a handsome brown-colored species seen at Guam but not secured; "bit at the finger when approached."

This splendid species is rather rare about Samoa, only 12 specimens being taken at Apia and Pago Pago. It is quite different from *Chætodon collaris* of the East Indies, with which it has been confounded by Günther, who gives a good figure, but the colors of the fish are brighter than his plate would indicate. The scarlet patch on the anal is especially characteristic.

Life colors of a specimen from Apia, black, dove-gray above and behind ocular band; spots on scales bright yellow below, gray above; edge of ocular stripe golden; forehead and snout drab; lips golden; dorsal drab, edged with golden, with a dark and white streak; caudal black, then drab, black, yellow, black, then a drab edge; anal black, being scarlet behind, with 2 black stripes, a dull yellow one, the edge white; ventral and breast black, continuous with ocular band; pectoral colorless.

1145. Chætodon unimaculatus Bloch. *Tifitifi pulepule; Tifitifi samasama.* Hawaii; Samoa; Tahiti; New Guinea (Macleay); Bonham I.; Faté (Seale); East Indies.

Chætodon unimaculatus Bloch, Ichth., taf. 201, 1787, **Tahiti.** Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 72, Tahiti. Günther, Fische der Südsee, 37, Bonham I., Tahiti, Samoa. Günther, Cat., III, 11, Amboina.
Chætodon sphenospilus Jenkins, Bull. U. S. Fish Comm., XIX, 1899 (1901), 395, **Honolulu.**
Tetragonoptrus unimaculatus, Bleeker, Atlas, Chæt., 45, tab. XIII. Java, Solor, Timor, Amboina, Ternate, Boro, Ceram, Banda.

This handsome species is widely diffused throughout the South Seas and to the East Indies and Hawaii. We have 20 examples from Samoa. The single black spot on the side well characterizes the species.

Life colors of a specimen from Apia, clear bright light yellow, becoming bluish gray below; ocular band broad, meeting below; faintly edged with gray; snout gray; golden edges to scales making faint oblique yellow streaks on shoulder; black lateral spot, broadly surrounded by gray, with a wedge-shaped downward extension of dusky gray; dorsal light bright yellow, a black bar across its posterior part and across caudal peduncle and anal fin, where it is narrower, the band bordered before and behind by gray, the posterior edge very narrow; caudal colorless; anal deep golden yellow, darker than dorsal; ventral deep golden yellow; pectoral colorless.

Another specimen was in life light golden above; gray beneath shoulders and front of sides, with V-shaped vertical bars of deep yellow, the angle directed toward the tail; ocular band very broad from front of dorsal, meeting across breast; snout and forehead gray; a large round black spot on middle of side of back, surrounded by gray; dorsal and anal clear yellow; a dark bar posteriorly on both, extending across caudal, edged on both sides with gray; posteriorly this is the margin of the dorsal and anal fins, both with whitish edge; caudal grayish white at base behind bar; rest of fin like pectoral, translucent with black dots; ventral golden yellow.

Compared with Hawaiian specimens there is a tendency in these to form a larger spot, more extensively produced into wedge-shaped process below. There is no other difference.

Chætodon unimaculatus differs strikingly from *Chætodon ephippium* and *ulietensis* in the teeth, which are stronger, not flexible, not more than two series functional, those of the two halves of each jaw converging toward median line. The horizontal series of enlarged scales on anterior part of sides are less marked than the oblique series, but are distinguishable and usually continuous with the horizontal series of smaller scales behind. The larger scales have margin unequally curved (*Lepidochætodon*), but this character seems to have little value.

1146. Chætodon trichrous Günther. Tahiti.

Chætodon trichrous Günther, Fische der Südsee, 40, pl. 36, **Tahiti; on a drawing.** Jordan & Snyder, Proc. U. S. Nat. Mus., XXIX, 1906, 355, fig. 2, Tahiti.

This species is known from an incorrect drawing made by Andrew Garrett, and published by Dr. Günther, and from a specimen, also from Tahiti, taken by Mr. Henry P. Bowie.

1147. Chætodon kleini Bloch. Yap; New Britain; East Indies.

Chætodon kleini Bloch, Ichth., IV, 7, taf. 218, fig. 2, after Klein. Günther, Cat., II, 22, Amboina. Mauritius. **Peters,** Berl. Mon. 1876, 832, New Britain.

Chætodon melanomystax Bloch & Schneider, Syst. Ichth., 1801, 224.
Chætodon melastomus Bloch & Schneider, op. cit., 224, **Tranquebar.**
Chætodon flavescens Bennett, Proc. Comm. Zool. Soc., 1830, I, 61, **Mauritius.**
Chætodon virescens Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 30, 1831.

1148. Chætodon ephippium Cuvier & Valenciennes. *Tifitifi taiona; Tifitifi ila; Tifitifi tusi.* Hawaii; Tahiti; Samoa; Kusai; Borabora; Guam; Tonga; New Guinea (Macleay); Woodlark I.; East Indies; Rarotonga, Raiatea, and Faté (Seale).

Chætodon ephippium Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 80, 1831, pl. 174, **Moluccas, Borabora, Tahiti.** Günther, Fische der Südsee, 36, taf. 27, Tonga, Tahiti. Seale, Bishop Museum 1901, 97, Guam.
Chætodon principalis Cuvier & Valenciennes, op. cit., 81, **East Indies;** on a drawing by Renard (young, showing a black area on and above the anal).
Chætodon mulsanti Thiollière, Fauna Woodlark, 168.
Tetragonopterus ephippium, Bleeker, Atlas, Chæt., 36, tab. XVI, Cocos, Java, Celebes, Flores, Timor, Ternate, Amboina, Ceram, Haruucka, Goram, New Guinea.

This beautiful species is common in the coral reefs about Samoa. We have also a specimen from Kusai, Caroline Islands.

The species is known at once by the large black saddle, with a long filament on the soft dorsal above it. It is well figured by Günther, although the ground-color is darker than indicated by him. A young example has the dark anal area indicated in the description of *Chætodon principalis.*

Twenty-five specimens from Apia and Pago Pago. Life colors of one from Apia, light grayish olive, side with five or six streaks of light violet; edge of opercle violet; side of head grayish; a grayish preorbital patch; black ocular stripe very narrow and faint; a narrow dark streak like a pencil-mark from fourth dorsal spine downward and forward nearly to base of pectoral, snout and breast bright orange-yellow, brighter anteriorly; a bright orange-yellow streak across base of pectoral within and without; back with black saddle, broadly edged below with white, spinous dorsal yellow at tip, then gray, then a black streak, then orange-brown, then olive with blackish lines, filaments orange, edged before with yellow, behind with white; soft dorsal black, edged with yellow, orange-brown, black, white, and finally blackish; anal white, edged with yellow, grayish orange, grayish yellow, and finally blackish, the yellow predominating, the orange a bright streak; caudal translucent dark gray with deep orange blotch at base, the edges and posterior border orange-yellow.

In adults the ocular band is well marked only on the upper and lower borders of the eye, rapidly fading out on the cheek and supraocular region. In young individuals it is continued downward and backward across cheek and interopercle, and upward and backward to meet its fellow at the nape, but even in the young it is most intensely black near the eye. In the young the anal fin is blackish with a broad, light, submarginal band and blackish edge, and the caudal peduncle is crossed by a black ring, widest at the mid-lateral line.

1149. Chætodon semeion Bleeker. Samoa; Tahiti; Thornton I.; Shortland I. (Seale).

Chætodon semeion Bleeker, Verh. Kon. Ak. Wet., XVII, Chæt. 67. Vierde Bijdr. Ichth. Cocos, Nat. T. Ned. Ind., VIII, 450, 1855, Keeling I. Günther, Fische der Südsee, 37, taf. 28, Tahiti, Samoa. Fowler, Proc. Ac. Nat. Sci. Phila. 1899, 492, Thornton I.
Tetragonopterus semeion Bleeker, Atlas, Chæt., 37, tab. XII (poor), Cocos, Celebes, Goram.

This species, one of the most beautiful of the group, is rare in the South Seas, and scarcely more common in the East Indies. We have but one specimen from Apia, which was colored in life as follows: Deep rich lemon-yellow or orange-yellow, with blue-black dots on the scales, forehead gray; ocular band black; pectoral and ventral lemon-yellow; dorsal yellow, streaked with blackish, the tips of the spines light clear yellow, a blue line separating this from the body color, last part of dorsal largely black, edged with dark yellow, light yellow, grayish and blackish, finally brownish; dorsal filament yellow; anal with less black and much more orange, otherwise similar, caudal light brownish, translucent behind, the upper and lower edge, also the middle brownish, a yellowish inner stripe lining the brown margin.

1150. Chætodon punctatofasciatus Cuvier & Valenciennes. Hawaii; East Indies.

Chætodon punctatofasciatus Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 28, no locality.
Chætodon punctatolineatus Gronow, Cat. Fish, ed. Gray, 1854, 70, locality unknown.
Chætodon multicinctus Garrett, Proc. Cal. Ac. Sci. 1863, 65, **Hawaii.** Günther, Fische der Südsee, 44, taf. 34, fig. B, Sandwich Is.
Tetragonopterus punctatofasciatus, Bleeker, Atlas, Chæt., 40, tab. XII, Buro, Obi-major, Solor, Amboina, Banda, Aneiteum.

Of this rare species very few specimens are known. The specimens from the Hawaiian Islands called *multicinctus* are probably identical with *Chætodon punctatofasciatus*, originally described from an unknown locality, but located by Bleeker in the East Indies.

Bleeker finds 6 to 8 dark bars on his species, and figures 8. Those seen by us, all from Hawaii, have, like the type of *Chætodon multicinctus*, but 6 bars.

1151. Chætodon miliaris Quoy & Gaimard. Hawaii.

Chætodon miliaris Quoy & Gaimard, Voy. Astrolabe, 380, **Maui, Hawaii.** Günther, Fische der Sudsee, in part, Sandwich Is. Steindachner, Sitz. Ak. Wiss. Wien 1900, 489, Honolulu, Laysan. Jordan & Evermann, Bull. U. S. Fish Comm., XXIII, 1903 (1905), 371, fig. 163, Honolulu.

Chætodon mantelliger Jenkins, Bull. U. S. Fish Comm., XIX, 1899 (1901), 394, **Honolulu.**

This little fish much resembles *Chætodon citrinellus*, but the lines of dots form vertical stripes, and the anal is nearly plain, without the broad stripes of black and of glossy yellow characteristic of *Chætodon citrinellus*. *Chætodon miliaris* seems to be confined to the Hawaiian Islands.[a]

1152. Chætodon citrinellus (Broussonet). *Tifitifi uli; Tifitifi laulifi; Manini.* Samoa; Fiji; Paumotu Is.; Bonham I.; Papua; Tahiti, Rarotonga; Raiatea and Faté (Seale).

Chætodon citrinellus (Broussonet) Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 27, **Guam.** Gunther, Fische der Sudsee, 47, pl. 35, fig. B (poor figure), Paumotu, Tahiti, Bonham, Samoa, Fiji. Jordan & Evermann, Proc. U. S. Nat. Mus. 1902, Formosa.

Tetragonoptrus miliaris, Bleeker, Atlas, Chæt., 39, tab. XV, Sumatra, Padang, Java, Celebes, Sangi, Ternate, Buro, Amboina, Ceram, New Guinea, not *Chætodon miliaris* of Quoy & Gaimard.

This species is distinguished from *Chætodon miliaris*, which it much resembles, by a bright golden stripe just above (dorsad) a jet black stripe along the edge of the anal fin. The dark stripes extend in most specimens for the whole length of the body. *Chætodon citrinellus* is one of the smallest species, rarely exceeding four inches. It is common about the coral reefs of Samoa. We have 15 specimens from Pago Pago and 50 from Apia.

Life colors of a specimen from Apia, dull light yellow olive, with series of blue spots along rows of scales; forehead brown, clear, ocular band narrowly edged above on both sides with grayish white, this border yellow-washed in larger examples, anal with a broad, black edge above a band of bright yellow; caudal plain orange, rather bright; soft dorsal yellow, with a narrow black, then a white line.

1153. Chætodon trifasciatus Park. *Tifitifi tala.* Hawaii; Samoa; Woodlark I.; Raiatea and Shortland I. (Seale); East Indies.

Chætodon trifasciatus Mungo Park, Trans. Linn. Soc., III, 34, 1792, **Sumatra.**

Tetragonoptrus trifasciatus, Bleeker Atlas Chæt., 36, tab. XV Sumatra, Java, Celebes, and all other East Indies.

Chætodon vittatus Bloch & Schneider, Syst. Ichth., 227, 1801, **Sumatra**, after Park. Gunther, Fische der Sudsee, 41, Paumotu. Gunther Cat., III, 23 Ceram, Amboina.

Chætodon tau-nigrum Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 32, **Guam**, young.

? *Chætodon austriacus* Ruppell Neue Wirbelthiere, 30, taf. 9, 1835, **Red Sea.**

Chætodon ovalis Thiolliere, Fauna Woodlark, 164, 1857, **Woodlark I.**

Chætodon melapterus (Guichenot) Maillard, Reunion, 6, **Ile de Reunion.**

This species is rather common about Samoa, 42 specimens being in our collection. It is rather rare about Honolulu, where it is taken, however. We have one young example corresponding to *Chætodon tau-nigrum*. The species is common in the East Indies.

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[a] We may here add an uncertain species.

Chætodon species.

Chætodon miliaris Günther, Fische der Südsee, 46, in part; coloration of taf. 35, fig. A, taken from a drawing by Garrett.

The coloration shown in Günther's plate of *Chætodon miliaris* is not at all that of the species in question, which is not known outside of Hawaii. We have notes on two young examples from Samoa corresponding to Gunther's plate, but we have not been able to find the specimens from which the notes were taken. These probably represent a species still undescribed.

Life colors of a specimen from Apia, olive yellow; clear yellow on head and breast, small bright blue stripes along rows of scales; soft dorsal with black edge, anal with a wider one, and a white stripe at base with one at edge; a black blotch on base of caudal peduncle, with two bright yellow spots and edged before and behind with pale, caudal behind bar whitish. Young.

Another specimen, from the same locality, was gray with oblique dark blue stripes upward and backward; whole outline of body deep golden yellow, ocular band broad, the part before it golden; dorsal and anal all golden, the soft dorsal dark at base and with a dark edge, the dorsal and anal brighter yellow near the edge; caudal colorless, a broad black bar at base surrounded by golden, this not on the fin.

Colors in life of a specimen from Apia, creamy orange, grayer above, with many streaks of violet blue; head with jaws blackish, forehead brown; a golden streak, then the ocular band, then a whitish streak, yellow below, then brownish, whitish, and purplish black, the black stripe parallel with the ocular band; spinous dorsal light yellow with a purplish line below; soft dorsal yellow, black, yellow, violet, gray-purplish, violet-gray, the outside creamy brown, the black surrounded by golden; caudal peduncle slaty, then whitish, golden, black, golden, and transparent, the black forming a broad bar; anal with a golden stripe at base, then black, becoming rich brown on spines, then golden, then dark brown, then golden, the black area surrounded by golden as on the dorsal; breast golden with a black blotch; ventral golden; pectoral pale yellow.

1154. Chætodon ornatissimus (Solander). *Tifitifi a'au.* Hawaii; Samoa; Tahiti; Guam; New Guinea; Rarotonga (Seale); East Indies.

Chætodon ornatissimus Solander, in Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 22, 1831, **Tahiti.** Günther, Fische der Südsee, 38, with plate, Sandwich Is. Seale, Bishop Museum 1901, 100, Guam.
Tetragonoptrus ornatissimus, Bleeker, Atlas, Chæt., 32, tab. XI, Amboina, New Guinea.
Chætodon ornatus Gray, Zool. Misc. 1834, 33, **Sandwich Is.**

A large and very handsome species generally common in the South Seas and northward to Hawaii. We have 15 examples from Hawaii and Pago Pago. It is readily known by the presence of six oblique stripes of orange on the side of the body.

Life colors of a specimen from Apia, gray; head and belly golden; five or six black vertical stripes across head, the interspaces yellow, these all parallel with the ocular band, which is the broadest; three orange bars before pectoral; six oblique stripes on body upward and backward, of rich orange-brown; a seventh stripe of dark brown on anal, this edged with a narrow black streak, then clear yellow, then black; dorsal with two yellow and a black stripe; caudal with two black stripes and a dull yellowish stripe between; base of fin gray; ventral golden; pectoral dull orange; breast anteriorly black at the meeting of the ocular bands.

1155. Chætodon bennetti Cuvier & Valenciennes. Tahiti; Paumotu Is.; Gilbert Is.; Kingsmill I.; East Indies.

Chætodon bennetti Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 84, **Sumatra.** Günther, Fische der Südsee, p. 37, pl. 29, fig. A, Paumotu, Tahiti, Gilbert Is., Kingsmill I.
Chætodon vinctus Bennett, Zool. Beechey's Voy. 62, pl. 17, fig. 1, 1849, **Sumatra.**
Tetragonoptrus bennetti, Bleeker, Atlas, Chæt., 34, tab. XIV, Sumatra, Java, Halmahera, Amboina.

1156. Chætodon speculum Cuvier & Valenciennes. New Guinea (Macleay); East Indies.

1157. Chætodon plebejus (Broussonet). South Seas (Tahiti?); New Guinea (Macleay); India.

Chætodon plebejus (Broussonet) Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 68, **South Seas.** Günther, Fische der Südsee, 35, taf. 32, fig. B, same specimen. Day, Fishes of India, 104, pl. 26, from Broussonet's specimens, Andaman Is.

This species was long known from Broussonet's original type only, supposed to be from the South Seas, and preserved in the British Museum for one hundred and thirty years. The presence of four anal spines would necessitate the reference of the species to *Megaprotodon*, but the number is certainly accidental, as in other regards the species is a true *Chætodon.* Day counts three dorsal spines only in his description, presumably drawn from a specimen from the Andaman Islands. His figure is from Broussonet's specimen and shows four. The species is recorded by Macleay from New Guinea.

1158. Chætodon quadrimaculatus Gray. Hawaii.

Chætodon quadrimaculatus Gray, Zool. Misc., 33, 1831, **Sandwich Is.** Günther, Fische der Südsee, 38, taf. 30, fig. A, Upolu, Sandwich Is. Jordan & Evermann, Bull. U. S. Fish Comm., XXIII, 1903 (1906), 373, pl. XLIX, Hawaii.

This fish is rather common about Honolulu. It has been recorded by Günther from Samoa, the figure published differing a good deal from our specimens of the fish. The species is well distinguished by the black back with two pale blotches and by the mesial yellow of the ocular stripe.

1159. Chætodon corallicola Snyder. Hawaii.

Chætodon corallicola Snyder Bull. U. S. Fish Comm., XXII, 1902 (1904), 53, with pl. 11, fig. 20, **Albatross Station 4032, on Penguin Bank, south coast of Oahu I.**

This species is known only from the specimens collected by the *Albatross.* It is a dull-colored species, with a broad, diffuse ocular band. It is an ally of *Chætodon flavirostris.*

1160. Chætodon fremblii Bennett. Hawaii; Laysan.

Chætodon fremblii Bennett, Zool. Journ. IV, 42, 1829, **Sandwich Is.** Günther, Fische der Südsee, II, 39, taf. 29, fig. B, Sandwich Is. Steindachner, Sitz. Ak. Wiss. Wien 1900, 488, Laysan.

Chætodon fremblii, Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 24, 1831: after Bennett.

This handsome species, well distinguished by its stripes of clear blue, has been found only about the Hawaiian Islands, where it is rather rare.

MICROCANTHUS Swainson.

Microcanthus Swainson, Class. Anim., II, 1839, 215 (*strigatus*).

This genus differs from *Chætodon* chiefly in the small scales, there being about 60 in the lateral line. The soft dorsal and anal are shorter than is usual in *Chætodon*, the fin formula of the typical species being dorsal XI,17; anal III,14. It is in fact doubtful whether the genus contains another species, as the other species with small scales have the soft fins many-rayed and constitute Bleeker's genus *Hemiiaurichthys* (type *polylepis*), which is apparently a valid genus, with no close relation to *Microcanthus strigatus*.

1161. Microcanthus strigatus (Cuvier & Valenciennes). Hawaii; East Indies.

This species, common in southern Japan and the East Indies, is occasionally taken about Hawaii. It was found there by Garrett, by Jenkins, and by Jordan & Evermann.

HENIOCHUS Cuvier & Valenciennes.

Heniochus Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 92, 1831 (*macrolepidotus*).

Taurichthys Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 146, 1831 (*varius*).

Diphreutes Cantor, Malayan Fishes, 159, 1850 (*macrolepidotus*); substitute for *Heniochus*, on account of *Henioche*, a prior genus of *Lepidoptera*.

This genus is characterized by the deep body and by the prolongation of one of the dorsal spines. The species are all marked by dark cross-bands.

1162. Heniochus acuminatus (Linnæus). *Laulaufau.* Hawaii; Samoa; Fiji; New Britain; New Hanover; New Guinea; East Indies.

Chætodon acuminatus Linnæus, Syst. Nat., ed. X, 272, 1758, **Indies**; after *Chætodon fascius 3-fusca*.

Chætodon macrolepidotus Linnæus, Syst. Nat., ed. X, 274, 1758, **Indies**; after *Chætodon lineis utruique 2-nigris*, of Artedi.

Heniochus macrolepidotus, Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 93, 1831, Molucca, Ile de France, Manila, New Guinea, Trincomalee. Günther, Fische der Südsee, 48, taf. 37, Polynesia.

Taurichthys macrolepidotus, Bleeker, Atlas, Chæt., 29, tab. V, fig. 1, Luzon, New Guinea, Singapore, Sumatra, and all East Indian islands.

This widely distributed species is not common in the South Seas. We have specimens from Hawaii and a single large specimen from Apia.

The latter in life showed the following colors: Head gray; snout black above, a gray streak between eyes; no ocular band; two black bands, the first including the short dorsal spines across to breast, ventrals, and whole front of anal; second including last dorsal spines and most of soft anal; a short white bar behind this; second dorsal and caudal bright golden; pectoral golden; lips pale; long spine white.

The name *acuminatus* has two pages priority over *macrolepidotus*.

1163. Heniochus permutatus Bennett. Tahiti; Samoa; New Guinea; Woodlark I.; East Indies.

Heniochus permutatus Bennett in Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 99, 1831, no locality.

Heniochus chrysostomus Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 99, 1831, **Tahiti.** Gunther, Fische der Südsee, 49, taf. 39, fig. A, Paumotu, Tahiti.

Taurichthys chrysostomus, Bleeker, Atlas, Chæt., 29, tab. IV, fig. 2, Flores, Ternate, Ceram, Amboina, Banda, Goram, New Guinea.

Heniochus melanistion Bleeker, Bydr. Ich. Banda. **Banda**

Heniochus drepanoides Thiollière, in Montrouzier, Fauna Woodlark Island, 166, **Woodlark I.**

This species is rather rare about Samoa, where 7 specimens were taken, 5 from Pago Pago, and 2 from Apia. It is apparently identical with the species called *Heniochus permutatus* by Bennett, succinctly described as having the colors of *Heniochus macrolepidotus* reversed, black for white and white for black.

Life colors of a specimen from Apia, 3 bands dark brown, the first blackish, alternating with white; yellowish tinged in places; the snout and lips orange; forehead dull orange with a black median stripe; dorsal colored like the body, the posterior part and caudal dull yellowish; ventral black; anal with a black, gray-edged ocellus in the center of the black area, most distinct in the young; long dorsal spines black, the tips of the spines whitish.

1164. Heniochus intermedius Steindachner. Pacific.

Heniochus intermedius Steindachner, Sitz. Ak. Wiss. Wien 1893, 222, locality unknown.

1165. Heniochus monoceros Cuvier & Valenciennes. Samoa (Günther); Tahiti; East Indies.

Heniochus monoceros Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 100, 1831, **Ile de France.** Günther, Fische der Südsee, 49, taf. 38, Samoa, Tahiti.
Taurichthys monoceros, Bleeker, Atlas, Chæt., 28, tab. III, fig. 3, Java.

This rare species is recorded by Dr. Günther from Samoa. It was not seen by us.

1166. Heniochus varius (Cuvier & Valenciennes). Samoa; East Indies.

Taurichthys varius Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 148, pl. 181, **East Indies.**
Taurichthys varius Bleeker, Atlas, Chæt., 27, tab. III, fig. 2, Batu, Java, Celebes, Timor, Amboina, Ceram, Banda.
Taurichthys viridis Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 152, **Amboina.**

One specimen of this species was taken by us at Apia. Otherwise the species is not recorded from Polynesia. Life colors, olive brown, blackish below where black streaks follow the rows of scales; lips, head, and nape black; breast gray, not black, as figured by Bleeker; a grayish olive band to front of spinous dorsal; a clear white bar from tip of long dorsal spine to lower base of caudal; dorsal olive, the first spines dusky; caudal pale olive; ventral, anal, and pectoral black.

HOLACANTHUS Lacépède. *Alamu.*

Holacanthus Lacépède, Hist. Nat. Poiss., IV, 525, 1803. (*H. tricolor;* scales large; caudal forked.)
Genicanthus Swainson, Class. Fishes, II, 212, 1839. (*G. lamarckii;* scales large; caudal forked.)
Centropyge Kaup, Wiegmann's Archiv, XXVI, 138, 1876. (*C. tibicen;* erroneously said to have four anal spines.)
Chætodontoplus Bleeker, Archiv Neerl. Sci. Nat., XII, 26, 1876. (*C. mesoleucus;* isthmus broad.)
Acanthochætodon Bleeker, Archiv Neerl. Sci. Nat., XII, 5, 1876. (*A. lepidolepis;* isthmus narrow; body elevated.)
Angelichthys Jordan & Evermann, Check-list of fishes, 420, 1896. (*A. ciliaris.*)

Preopercle with a stout spine; dorsal spines 12 to 14. The species of this genus are almost all gaudily colored and some of them reach a large size. They differ widely among themselves, but not so as to permit generic subdivision. The different subgeneric groups—*Holacanthus*, with relatively large scales and angular dorsal and anal; *Angelichthys*, with strong spines on the preopercle; *Chætodontoplus*, with very small scales and rounded dorsal and anal; *Acanthochætodon*, with moderate sized scales and elevated dorsal and anal—are recognizable groups. Another subgenus equally well marked may be based upon *Holacanthus fisheri*, a species with strong spines on the preorbital. Most of the species in the South Seas belong to the typical subgenus *Holacanthus*.

1167. Holacanthus diacanthus (Boddaert). *Aimeo; Alamu.* Samoa; Paumotu Is; Tahiti; New Guinea; East Indies.

Chætodon diacanthus Boddaert, De Chæt., 1772.
Holacanthus diacanthus Günther, Fische der Südsee, 50, taf. 40, fig. B, Samoa, Tahiti, Paumotu. Bleeker, Atlas, Chæt., 65, tab. VI, fig. 5, Celebes, Flores, Ceram, Java, Amboina, Timor, New Guinea, Banda.
Chætodon fasciatus Bloch, Ichth., taf. 195, 1788, after Boddaert.
Chætodon boddaerti Gmelin, Syst. Nat., 1243, 1788, after Boddaert.
Chætodon dux Gmelin, Syst. Nat., 1256, 1788, after Bloch.

This lavishly gaudy fish is very common about the coral reefs of Samoa. About 16 specimens were preserved from Apia and Pago Pago. Life colors of one from Apia, about 9 broad curved stripes, pale blue with dark-blue edges, the interspaces deep orange-yellow, pale yellow below; another narrow blue stripe at base of caudal; two others above eye; lips yellow; a blue curved streak below eye;

lower parts livid gray; stripes of body extending back on dorsal above them, in paler yellow and purplish blue; upper part of fin of deep orange with two pale-blue stripes with dark-blue edge; second dorsal almost black-orange, washed with dark; caudal light clear yellow, with a few dark specks; anal with many stripes of steel-blue and orange, the margin black-blue; ventral golden-yellow, edged anteriorly with dusky; pectoral colorless; a median blue streak on forehead; serrated edge of preopercle blue; preopercular spine blue.

1168. **Holacanthus bicolor** Bloch. *Ulapua.* Samoa; Hawaii (Günther); Solomon Is.; New Guinea; East Indies.

Chætodon bicolor Bloch, Ichth., taf. 206, **Indies**; plate from this species; description confused with the American species, *H. tricolor.*

Holacanthus bicolor, Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 168, 1831, East Indies. Gunther, Fische der Südsee, 51, taf. 39, fig. B, Samoa, Solomon Is., Hawaii. Bleeker, Atlas, Chæt., 61, tab. VII, fig. 3, Sumatra, Flores, Solor, Ternate, Ceram, Amboina, Saparua, Banda, Aru, New Guinea.

This handsome species is moderately common about the coral reefs of Samoa. We did not find it at Hawaii, and it is possible that Garrett's sketch on which the Hawaiian record rests was made at Tahiti. The coloration of this species is almost exactly that of the West Indian "rock beauty," *Holacanthus tricolor*, but the form of the body and fins is different.

Four specimens were taken at Apia, and 8 at Pago Pago. Life colors of one from Pago Pago, anteriorly brilliant yellow, slightly brownish tinged above pectoral, bordered behind by clear yellow which covers throat, breast, pectoral, and ventral; body posteriorly lustrous blue-black, the color including anal and most of dorsal; caudal and end of caudal peduncle brilliant yellow; a broad, blue-black bar connecting eyes above, this bar fading below; an orange spot above gill-opening; edge of opercle orange; lower lip slightly bluish; four orange spots below it, the anterior largest; spine of preopercle grayish blue.

1169. **Holacanthus flavissimus** Cuvier & Valenciennes. *Lega; Aimeo.* Ulea; Samoa; Fiji; Tahiti; New Hebrides; Harvey Is.; Kingsmill I.; Raiatea.

Holacanthus flavissimus Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 197, 1831, **Ulea.**

Holacanthus luteolus Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 197, 1831, **Tahiti**; on a drawing by Parkinson.

Holacanthus cyanotis Günther, Cat., II, 517, 1860, **Aneiteum.** Günther, Fische der Südsee, 52, taf. 40, fig. A, New Hebrides, Kingsmill, Tahiti, Harvey, Samoa, Fiji.

Holacanthus monophthalmus Kner, Sitz. Ak. Wiss. Wien 1867, 714, fig. 2, **Raiatea**, young. Kner, op. cit., 1868, 16, Savay.

Holacanthus ocularis Peters, Berl. Mon. 1868, 147, **South Seas.**

Five specimens from Apia, 12 from Pago Pago. This beautiful species is rather common about the coral reefs of Samoa. The first good account of it is that of Dr. Günther, under the name of *Holacanthus cyanotis*. *Holacanthus flavissimus* is evidently the same, the blue markings on the head being inconspicuous in faded specimens.

Life colors of a specimen from Apia, clear deep yellow, citron-yellow below, fins all the same; dorsal, anal, and caudal with very narrow bright blue edge; a deep blue ring around orange eye; a deep violet-blue bar on opercle with an orange edge behind; preopercular spines and two bars across chin slaty blue; two slaty spots on breast; upper lip slaty. Gill membranes scarcely joined to isthmus.

1170. **Holacanthus bispinosus** Günther. *Tu'u'u pulepule mumu.* Hawaii (Günther); Samoa; Tahiti; New Hebrides; Amboina.

Holacanthus bispinosus Gunther, Fische der Südsee, 51, pl. 56, fig. C, **Tahiti, New Hebrides, Hawaii.** Bleeker, Atlas, Chæt., 60, tab. VI, fig. 1, Amboina.

This very small and neatly colored species resembles a *Pomacentrus.* It is rare about the reefs at Tutuila, but two specimens being taken at Pago Pago. It was not found by us at Hawaii. The plate in the Fishes of Hawaii is taken from a specimen from Pago Pago.

Life colors, deep orange- or copper-red, clearer below; the head, back, and vertical fins blue-black, the dark color forming about 18 narrow dark cross streaks on side as wide as the ground color; breast and belly orange; sides of head dull orange, the lips and spines violet; lower lip very bright blue; anal and dorsal edged with blue; caudal with a broader blue stripe inside the margin; pectoral yellow, dusky at base; ventral orange, edged with blackish.

1171. **Holacanthus navarchus** Cuvier & Valenciennes. New Guinea (Macleay); East Indies.

1172. Holacanthus loriculus Günther. Tahiti.

Holacanthus loriculus Günther, Fische der Südsee, 53, taf. 40, fig. 6, **Tahiti.**

This species is known only from a drawing by Mr. Garrett of a specimen 2½ inches long, taken from the stomach of an *Epinephelus* at Tahiti.

1173. Holacanthus arcuatus Gray. Hawaii.

Holacanthus arcuatus Gray, Zool. Misc. 33, 1831, **Hawaii.** Günther, Fische der Südsee, 50, taf. 32, fig. C, same specimen.

Of this species only the original type specimen from Hawaii is known.

1174. Holacanthus fisheri Snyder. Hawaii.

Holacanthus fisheri Snyder, Bull. U. S. Fish Comm., XXII, 1902 (1904), 532, pl. 11, fig. 21, **Hawaii.**

This species, notable for the great size of its preorbital spines, is known from numerous specimens taken about the Hawaiian Islands.

1175. Holacanthus imperator (Bloch). Papua; Guam; Tahiti; Paumotu Is.; East Indies.

Chætodon imperator Bloch, Ichth., taf. 94, 1788, **Moluccas.**
Holacanthus imperator, Günther, Fische der Südsee, 53, taf. 41, fig. A, Tahiti, Paumotu, Ile de France, Red Sea. Seale, Bishop Museum, vol. 1, no. 3, 101, 1901, Guam.
Acanthochætodon imperator, Bleeker, Atlas, Chæt., 70, tab. V, fig. 2, pl. 12, fig. 4, Celebes, Amboina, New Guinea.

This large and showy species was not seen by us at Samoa.

1176. Holacanthus marianas Seale. Guam.

Holacanthus marianas Seale, Bishop Museum, vol. 1, no. 3, 104, 1901, **Guam.**

This species, apparently distinct from *H. imperator*, is unknown to us.

1177. Holacanthus nicobariensis (Bloch & Schneider). Samoa; Misol; Tahiti; Waigiu; Guam; East Indies.

Chætodon nicobariensis Bloch & Schneider, Syst. Ichth., 219, pl. 50, **Nicobar Is.**; misprinted *Nicobarcensis*, an error corrected in the errata.
Holacanthus nicobariensis, Günther Fische der Südsee, 54, Misol, Tahiti, Samoa. Seale, Bishop Museum, vol. 1, no. 3, 106, 1901, Guam.
Acanthochætodon nicobariensis, Bleeker, Atlas, Chæt., 69, in part (the plate represents some other fish), Timor Amboina, Ceram, Waigiu.
Holacanthus geometricus Lacépède, Hist. Nat. Poiss., IV, 537, 1803.

This beautiful fish seems to be rare about Samoa. A single young specimen was taken in a tidepool at Pago Pago. Life colors, blue-black, the concentric streaks part white, part pale blue, the widest and the fin edgings pure white; ventrals blue edged.

1178. Holacanthus bishopi Seale. Guam.

Holacanthus bishopi Seale, Bishop Museum, vol. 1, no. 3, 106, 1901, **Guam.**

This species is apparently distinct from *H. nicobariensis.*

1179. Holacanthus semicirculatus Cuvier & Valenciennes New Guinea (Macleay); Waigiu; New Ireland; Woodlark; East Indies.

Holacanthus semicirculatus Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 191, **Buru, Waigiu, New Ireland.**
Acanthochætodon semicirculatus Bleeker, Atlas, Chæt., 69, pl. 8, fig. 5, Sumatra, Java, Timor, and the islands of the East Indies generally.
Chætodon microlepis Bleeker, Fish. Sumatra, 257, **Sumatra.**
Holacanthus buru Thiollière, in Montrouzier, Fauna Woodlark, 169, 1857, **Woodlark I.**

This species, common in the East Indies, extends eastward to Melanesia, but has not been found about Samoa.

1180. Holacanthus alternans Cuvier & Valenciennes. New Britain; Madagascar.

Holacanthus alternans Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 193, 1831, **Madagascar.** Peters, Berl. Mon. 1876, 832, New Britain.

Family ZANCLIDÆ.

ZANCLUS (Commerson Ms.) Lacépède.

Zanclus (Commerson Ms.) Lacépède, Hist. Nat. Poiss., IV, 473, 1803 (*cornutus*).
Pomacanthus Lacépède, Hist. Nat. Poiss., IV, 1803, 517 (*canescens*, etc.).
Zanclus Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 102, 1831 (*cornutus*).
Gonopterus Gronow, Cat. Fish., ed. Gray, 77, 1854 (*mœrens*).
Gnathocentrum Guichenot, Ann. Maine et Loire, IX, 1866, 4 (*centrognathum;* young).

1181. Zanclus canescens (Linnæus). *Tifitifi; Galafa.* Hawaii; Samoa: Papua; Waigiu; Woodlark I.; East Indies; Revillagigedo Is.

Chætodon canescens Linnæus, Syst. Nat., ed. X, 272, 1758, **Indies;** after Artedi, young.
Pomacanthus canescens Lacépède, Hist. Nat. Poiss., IV, 517, 1803.
Zanclus canescens Günther, Cat., II, 493, 1860. Bleeker, Atlas, 78, tab. V, fig. 3, 1877-8, Celebes, Amboina. Jordan & Fowler, Proc. U. S. Nat. Mus., 549, 1902, Misaki (Japan).
Chætodon cornutus Linnæus, Syst. Nat., ed. X, 273, 1758 after Artedi, adult. Lacépède, Hist. Nat. Poiss., IV, 473, 1803, pl. 2, fig. 1. Jordan & Evermann, Fish North and Mid. Amer., II, 1687, 1898.
Zanclus cornutus Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 102, pl. CLXXVII, 1831. Bleeker, Atlas, 77, tab. IV, figs. 1, 2, 1877-8, Sumatra, Java, Celebes, Ceram, New Guinea, Waigiu, etc.
Zanclus centrognathus Cuvier & Valenciennes, Hist. Nat. Poiss., VII, 528, 1831, **near equator, 75 E.**
Gonopterus mœrens Gronow, Cat. Fish., ed. Gray, 77, 1854, **India.**
Chætodon nudus Gronow, Cat. Fish., ed. Gray, 76, 1854, **Mari indico.**
Zanclus montrouzieri Thiollière, in Montrouzier, Fauna Woodlark, 168, 1857, **Woodlark I.**

This species is everywhere common throughout the Pacific Ocean, from the off-shore islands of Mexico to Hawaii and southern Japan. We have 20 examples from Apia and 3 from Pago Pago.

Family ACANTHURIDÆ.

HEPATUS Gronow, 1763.

(*Teuthis* Linnæus, 1766; *Harpurus* Forster; *Acronurus* Gronow, 1854.)

1182. Hepatus achilles (Shaw). *Pone i'umumu.* Hawaii; Samoa; Marcus I.; Rarotonga and Makatea (Seale).

This beautiful fish is rare about Samoa, as about Hawaii. We have two large specimens from Pago Pago and one from Apia. The red tail-patch is very brilliant in life.

1183. Hepatus aliala (Lesson). *Alamea samasama; Loata.* Oualan; Samoa; New Guinea; Guam; Clarion Is.

This well-marked species is not rare about Samoa. We have ten specimens from Apia and Pago Pago. It is found also on the off-shore islands of Mexico.

Life colors of a specimen from Apia, called *alamea samasama*, olive-black; pure black in front; dorsal dusky mottled olive with black and blue edge, and a bright yellow line at base, which widens and covers most of last ray of dorsal; caudal drab gray with a pale violet-gray edge and a golden crescent; spine golden; anal like dorsal in color; pectoral and ventral blackish, both edged with grayish blue, edged in front with sky-blue; a whitish patch below eye and a white ring around throat behind chin; edge of opercle light golden olive.

1184. Hepatus olivaceus (Bloch & Schneider). Tahiti; Paumotu Is.; Samoa; Palau Is.; Hawaii; New Guinea; East Indies.

This species, easily recognized by the mark at the shoulder, is frequently taken about Hawaii and Samoa. We have 5 examples from Samoa.

Color in life of a specimen from Apia, lemon-yellow, olive-shaded above; fins all yellow with dark edgings; axil and tip of caudal bright orange-yellow; a blackish brown stripe on pectoral, extending to its middle, without edging in young. Another specimen from Apia was black, with orange-black edged stripe, and a third was bright brownish yellow, the black stripe mesially bright orange.

1185. Hepatus pyriferus (Kittlitz). Ulea.

Acanthurus pyriferus Kittlitz, Senckenberg Museum, I, 193, taf. 12, fig. 2, 1834. **Ulea.** Gunther, Fische der Sudsee, 113.
Acanthurus armiger Cuvier & Valenciennes, Hist. Nat. Poiss., X, 234, 1835.

This species is unknown to us.

1186. Hepatus nigricans (Linnæus). *Uliuli maia; I'u sina.* Tahiti; Paumotu Is.; Samoa; Fiji; Harvey Is.; Bougainville Is.; Gilbert Is.; New Guinea; East Indies.

Chætodon nigricans Linnæus, Syst. Nat., ed. x, 1758, **Red Sea; after Artedi.**
Chætodon gahhm Forskål, Descr. Anim., 64, **Red Sea.**
Acanthurus gahm, Günther, Fische der Südsee, 113, taf. 74, Tahiti, Paumotu, Samoa, Harvey Is., Bougainville Is., Gilbert Is.

This widely distributed species is rather common about Samoa. We have ten specimens. In all the adult specimens the caudal fin has no white ring at base, being except for the pale crescent at tip dark brown like the body. In one young example the caudal fin is abruptly gray.

The name *Chætodon nigricans*, based on a fish from the Red Sea, dusky, with the caudal whitish, could be no other species. *Acanthurus doreënsis* is probably the same, the anal rays miscounted.

Life colors of a specimen from Apia called *uliuli maia*, very dark olive; fins black; a black oblong stripe or spot behind gill opening on level of eye extending about to middle of pectoral; this is black, faintly and narrowly edged with pale blue; pectoral with a golden vertical stripe, behind which the fin is colorless; caudal conspicuously edged with white; dorsal and anal with dark and light blue, the streak very narrow, faint on dorsal; ventral reddish brown on inner rays; no white spot before eye; lips dark; no caudal ring nor axil spot.

A specimen from Pago Pago called *i'u sina*, was black, with brownish shade; no streaks, but a sanding of darker specks; a horizontal oblong black stripe or spot from angle of gill opening toward near end of pectoral; fins all black, the anal narrowly edged with clear blue; dorsal more narrowly edged with black; caudal very lunate, edged with white; pectoral with a bright yellow cross-bar.

1187. Hepatus doreensis (Cuvier & Valenciennes). New Guinea.

Acanthurus doreënsis Cuvier & Valenciennes, Hist. Nat. Poiss., x, 220, **Dorey Harbor (New Guinea).**

This species has the coloration of the young of *Hepatus nigricans*. It is said, however, to have but 20 soft rays in the anal fin, a number lower than in any other species. It is perhaps the young of *Hepatus nigricans*, perhaps that of *H. elongatus*, a species in which the caudal shows usually a narrow pale edge. It is, however, by Macleay recorded as a distinct species.

1188. Hepatus aterrimus (Günther). Samoa.

Acanthurus aterrimus Günther, Proc. Zool. Soc., 1871, 660, **Savay.** Günther, Fische der Südsee, 114, taf. 77, fig. B, Savay.

This species, described from Samoa, was not seen by us. The deep body and the white crescent on the caudal are the characteristic traits.

1189. Hepatus lineatus (Gmelin). *Alogo.* Tahiti; Samoa; Guam; New Guinea; Faté (Seale); Zanzibar.

Chætodon lineatus Gmelin, Syst. Nat., 1246, 1789, **"America, Australis et India."**
Acanthurus lineatus Günther, Fische der Südsee, 111, taf. 70, Samoa, Tahiti, Zanzibar. Kner, Novara Fische, 210; Tahiti. Streets, Bull. U. S. Nat. Mus., VII, 100, Samoa.
Teuthis lineatus Seale, Bishop Museum, 1901, 106, Guam.

This gaudily colored species is very common about Samoa. We have about 50 examples from the reefs at Apia and Pago Pago.

Life colors of a specimen from Apia, deep blue stripes, each with a pale median line, alternating with golden stripes; belly livid blue, the breast golden, the region behind ventrals orange; two golden and two vertical cross-stripes at base of tail; dorsal olive with pale blue stripes and blue edge; caudal blackish with blue crescent; anal olive-green, pale blue at edge, orange at base; ventral orange, with a deep blue edge; pectoral orange at base, dusky behind, with sky-blue spots.

1190. Hepatus dussumieri (Cuvier & Valenciennes). New Guinea; Hawaii; East Indies.

Acanthurus argenteus Quoy & Gaimard, Voy. Uranie, 373, 1824, pl. 63, fig. 3, **Maui**; larva, the species uncertain, nearest *Teuthis dussumieri*, perhaps *T. matoides*.
Acanthurus dussumieri Cuvier & Valenciennes, Hist. Nat. Poiss., x, 201, 1835, **Ile de France.** Günther, Fische der Sudsee, 112, taf. 72, Hawaii. Steindachner, Sitz. Ak. Wiss. Wien 1900, 493, Honolulu.
? *Acanthurus lineolatus* Cuvier & Valenciennes, Hist. Nat. Poiss., x, 207, 1835, Indian Ocean.

This species is the commonest of its genus about the Hawaiian Islands. We did not find it at Samoa.

1191. Hepatus atramentatus Jordan & Evermann. Hawaii; Samoa; Laysan; Marcus I.; Tahiti.

Acanthurus lineolatus Günther, Fische der Südsee, 112, taf. 73, fig. A, **Tahiti**; not of Cuvier & Valenciennes. Steindachner, Sitz. Ak. Wiss. Wien 1900, 493, Honolulu.

Teuthis atramentatus (by misprint *atrimentatus*) Jordan & Evermann, Bull. U. S. Fish Comm., XXII, 1902 (1903), 198, **Hawaii.** Snyder, Bull. U. S. Fish Comm., XXII, 1902 (1903), 533, **Laysan.** Bryan & Herre, Bishop Museum 1903, 133, Marcus I.

Of this species, rather common at Hawaii, we found but one specimen in Samoa. The body is striped with blue, as in *Hepatus dussumieri*, but there is an ink-like spot at the base of the last dorsal and anal rays.

1192. Hepatus elongatus Cuvier & Valenciennes. *Unauau.* Hawaii; Samoa; New Hebrides; Palau; Tahiti; Marcus I.; Guam; Faté, and Tubuai (Seale).

Chætodon elongatus Lacépède, Hist. Nat. Poiss., IV, 471, pl. 6, fig. 2, 1803, **Pacific Ocean.**

Acanthurus nigroris Cuvier & Valenciennes, Hist. Nat. Poiss., X, 208, 1835, **Hawaii.**

Acanthurus bipunctatus Günther, Cat., III, 331, **Sea of China, Fiji Is.** Steindachner, Sitz. Ak. Wiss. Wien 1900, 494, Honolulu.

Acanthurus nigros Günther, Cat., III, 332, **New Hebrides.** Günther, Fische der Südsee, 110, New Hebrides, Palau, Tahiti.

Teuthis bipunctatus Jordan & Fowler, Proc. U. S. Nat. Mus. 1901, 564, Riukiu Is., Kotosho, Formosa. Bryan & Herre, Bishop Museum 1903, 134, Marcus I.

Teuthis mata Seale, Bishop Museum, 1901, 107, Guam; not of Cuvier & Valenciennes.

This species is common about Samoa, and also about Hawaii. It is often distinguishable by the black blotch at base of soft dorsal and anal, but in dark colored examples, as most of ours are, this spot is inseparable from the black ground-color of the fins. The body is very dark brown, without stripes. *Hepatus mata* Cuvier & Valenciennes of India, has the same color but the profile is straight and not so steep.

Of the various names given to fishes of this sort we have chosen as earliest the name *elongatus* of Lacépède. While his description amounts to little, and that of Cuvier & Valenciennes is scarcely better, his figure represents this species, which differs from all others in being plain blackish brown on body and fins, the black spot on last rays of dorsal and anal distinct only in paler specimens.

In this species the body is uniform brown; the caudal has usually a narrow pale edge and the snout is usually dusky.

1193. Hepatus fuliginosus (Lesson). Oualan, or Strong I.

Acanthurus fuliginosus Lesson, Voy. Coquille, II, 149, pl. 27, fig. 2, 1830, **Oualan.**

This species is said to have the lips blue, the body brownish with faint bluish streaks, and but 20 soft rays in the anal. We have not seen it. It may be identical with *Hepatus elongatus*.

1194. Hepatus bariene (Lesson). Waigiu.

Acanthurus bariene Lesson, Voy. Coquille, II, 149, 1830, **Waigiu.**

Acanthurus nummifer Cuvier & Valenciennes, Hist. Nat. Poiss., X, 234, 1835, **Waigiu;** same type.

1195. Hepatus celebicus (Bleeker). Tahiti; Solomon Is.; East Indies.

Acanthurus celebicus Bleeker, 1852, 761, **Celebes, Ternate.** Gunther, Fische der Sudsee, 115, taf. 73, fig. B, Solomon Is., Tahiti.

1196. Hepatus leucopareius (Jenkins). Hawaii.

Teuthis leucopareius Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (1903), 476, fig. 28, **Honolulu.**

1197. Hepatus matoides (Cuvier & Valenciennes). *Umelei.* Hawaii; Samoa; Fiji; Oualan; Bougainville I.; New Guinea; East Indies.

Acanthurus matoides Cuvier & Valenciennes, Hist. Nat. Poiss., X, 204, 1835, Oualan. Sauvage, Poiss. Madagascar, 340; same type. Peters, Berl. Mon. 1876, 845, Bougainville I.

Acanthurus annularis Cuvier & Valenciennes, op. cit., X, 209, 1835, **Ile de France.**

Acanthurus blochii Cuvier & Valenciennes, op. cit., X, 239, 1835, **Ile de France, Seychelles.**

Acanthurus xanthopterus Cuvier & Valenciennes, op. cit., X, 215, 1835, **Seychelles.**

Acanthurus lamarrei Cuvier & Valenciennes, op. cit., X, 236, 1835, **Ile de France.**

Teuthis guntheri Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (1903), 477, pl. 29, **Hawaii.**

This species is characterized by the pale ring at the base of the caudal, the body being plain brown or nearly so, and the vertical fins with a few distinct stripes. Taking the account given by Sauvage as authentic, we are unable to separate the species called *xanthopterus*, *blochi*, and *guntheri* from the scantily described *matoides*.

The species is common about Hawaii, and Samoa as well. We have about a dozen specimens from Samoa from 2 to 10 inches in length. The largest, a little more elongate than shown in Jenkins's figure, shows a very distinct bluish streak along base of dorsal. This, with the pale caudal band and the yellow margin to the pectoral, are characteristic of this species.

Life colors of a young specimen from Apia, dusky olive, with very faint bluish horizontal streaks; a whitish olive ring around caudal peduncle; dorsal and anal with faint bluish horizonal streaks; pectoral more or less pale.

1198. Hepatus bishopi (Bryan & Herre). Marcus I.

Teuthis bishopi Bryan & Herre, Bishop Museum 1903, 134, **Marcus I.**

This species is based on an adult example, very close to *Hepatus matoides* but probably distinct, as the pectoral is without yellow and the dorsal and anal not striped. The profile is also somewhat S-shaped.

1199. Hepatus umbra (Jenkins). Hawaii.

Teuthis umbra Jenkins, Bull. U. S. Fish Comm., xxii, 1902 (1903), 477, **Honolulu.**

This species is rather rare about Honolulu. It is very similar to *Hepatus matoides*, differing chiefly in the absence of lines on the fins.

1200. Hepatus aquilinus Jordan & Seale, new species. *Palagi samasama.*

This species is allied to *Hepatus matoides*, but is much more elongate, with the profile more convex than in any other species, the general form more distinctly elliptical. We have a single very large specimen from Apia

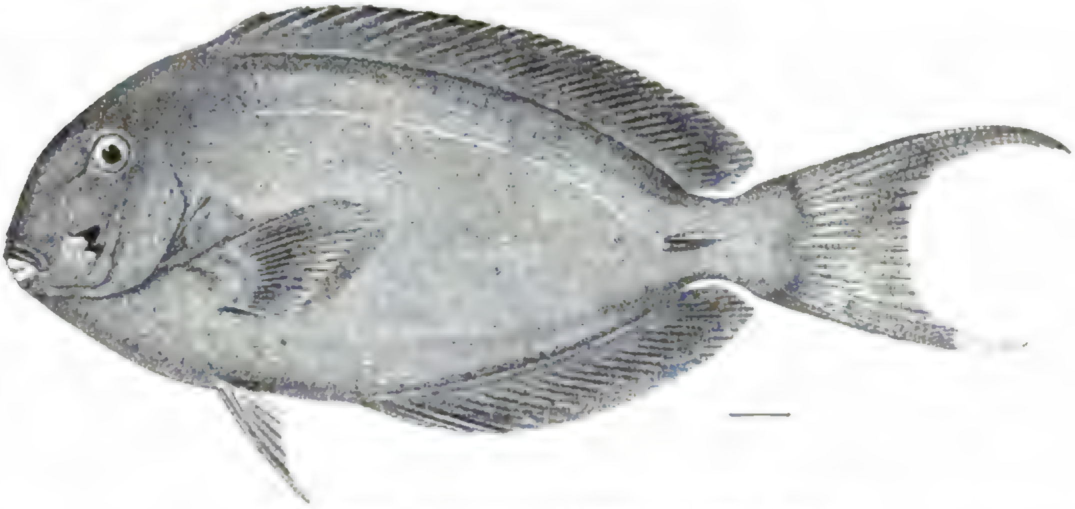

Fig. 66.—*Hepatus aquilinus* Jordan & Seale, new species. Type.

Head 4 in length; depth 2.12; eye 5 in head; dorsal ix, 26; anal iii, 24; scales small, about 1.25 in lateral line; snout 1.25 in head; interorbital 2.85; spine on caudal peduncle fully a third greater than width of orbit.

Body compressed, elevated, anterior profile rounded, slightly gibbous in front of eye; depth of caudal peduncle 2.50 in head, the spine distinct, equal in length to about two-thirds of depth of peduncle; mouth small; teeth flat, their margin toothed, 16 teeth in upper jaw, 21 in lower jaw; distance from tip of snout to origin of dorsal 2.55 in length without caudal; posterior margin of dorsal rounded, its longest ray 2 in head; base of anal 2 in length without caudal, 1.45 in base of dorsal, longest anal ray 2 in head; pectoral equal to head; ventral 1.25 in head; caudal deeply lunate, the marginal rays being prolonged, longest outer ray 2.50 in length without caudal, middle ray 1.50 in head.

Color in life, purplish brown with some bluish shades on tail; very faint traces of stripes; dorsal with four horizontal olive-bronze and gray stripes; anal with five and a dark edge; caudal very deeply lunate; pectoral with posterior half golden; ventral dark olive; no black spot on dorsal or anal; caudal dark, without pale edge; caudal peduncle dark; olive about eye, and a streak to snout.

Color in spirits, uniform dark brown, shaded somewhat darker, almost black at tip of snout and chin; base of caudal spine dusky; all the fins except pectoral dusky, almost black, darker than body color; anterior two-thirds of pectoral dusky, posterior third yellowish white; no black spots at axil of any fins; iris golden.

Type no. 51759, U. S. National Museum, from Apia, length, 17 inches.

1201. Hepatus flavoguttatus (Kittlitz).

Acanthurus flavoguttatus Kittlitz, Senckenberg Museum, 196, 1834, **Caroline Is.**
Acanthurus kittlitzi Cuvier & Valenciennes, Hist. Nat. Poiss., x, 222, 1835, **Caroline Is.**

1202. Hepatus marginatus (Cuvier & Valenciennes). Caroline Is.

Acanthurus marginatus Cuvier & Valenciennes, Hist. Nat. Poiss., x, 221, 1835, **Luganor, one of the Carolines.**

1203. Hepatus triostegus (Linnæus). *Manifi.* Samoa; Tahiti; New Guinea; Fiji; Faté; Rarotonga and Nukahiva (Seale); East Indies.

Acanthurus zebra De Vis, Proc. Linn. Soc. N. S. W., 1884, 447, **Duke of York I.**

This species is the most abundant of the genus about Samoa, swarming everywhere on the reefs. The black bar through the pectoral does not descend much below the fin, the caudal mark is a vertical bar or else two spots in a vertical line, and the adults have the white of the belly bounded above by an undulating dark line.

Life colors of a specimen from Apia reef, called *manifi*, light olive, darker on back, silvery below; bars black. This seems like *sandwichensis*, but lacks one cross-band and is very pale; only four bands on sides.

1204. Hepatus sandvicensis (Streets). Hawaii; Johnston I.; off shore islands of Mexico.

Acanthurus triostegus sandvicensis Streets, Bull. U. S. Nat. Mus., VII, 67, 1877, **Honolulu.**
Acanthurus triostegus, Smith & Swain, Proc. U. S. Nat. Mus. 1882, 138, **Johnston I.** Steindachner, Sitz. Ak. Wiss. Wien, 1900, 493, Honolulu, Laysan.
Truthis triostegus, Jordan & Evermann, Fishes North & Mid. Amer., II, 1690 (description not synonymy), 1898, off-shore islands of Mexico.

This is the most abundant species of the genus about Hawaii, where it replaces the closely allied *Hepatus triostegus*. The differences, although slight, are constant.

1205. Hepatus guttatus (Forster). *Moana; Aau.* Tahiti; Hawaii; Samoa; New Hebrides; Kingsmill I.; Palau; Guam; New Guinea.

Acanthurus guttatus Forster, in Bloch & Schneider, Syst. Ichth., 1801, 215. Günther, Fische der Südsee, 109, taf. 69, fig. A, New Hebrides, Tahiti, Samoa, Kingsmill I., Palau, Sandwich I. Seale, Bishop Museum 1901, 110, Guam.

This strongly marked species is common at Samoa, whence we have 20 specimens. At Hawaii it is rather rare.

Life colors of a specimen from Apia, called *moana* and *a'au*, dark brownish olive, paler olive behind; a whitish vertical bar above vent; spots on posterior parts white; caudal olive-yellow, blackish behind; ventral bright yellow, dusky edged; pectoral dusky olive, paler above; no yellow; anal dull orange.

LARVAL FORMS OF HEPATUS.

Larval forms of *Hepatus*, constituting the supposed genus *Acronurus* of Günther, abound in all warm seas. In all cases, these are deep in body, with a large silvery area on the thorax, and with the scales replaced by vertical striæ. These forms can be identified only with great difficulty, and chiefly by means of the count of fin-rays. The following have been described from the Pacific Ocean:

Acanthurus argenteus Quoy & Gaimard, Voy. Uranie, 373, pl. 63, fig. 2, 1824, **Maui.** This is probably the young of *Hepatus dussumieri*, possibly of *Truthis matoides*.

Acanthurus striatus Quoy & Gaimard, Voy. Uranie, 373, pl. 63, fig. 3, 1824, **Guam.** This is regarded by Günther as the young of *Ctenochætus strigosus* (*striatus*), an identification which is probably correct. We have, however, three different species of young fish, all having the coloration ascribed to *Acanthurus striatus*, two of them from Samoa and one from Tahiti. We can identify but one of them, the *Ctenochætus*, which is, without much doubt, the form originally named *striatus* by Quoy & Gaimard.

Acanthurus orbicularis Quoy & Gaimard, in Cuvier & Valenciennes, Hist. Nat. Poiss., x, 237, 1835, **Guam.** This can not be identified.

Acanthurus brevispinus Günther, Cat., III, 346, 1861, from unknown locality; defies conjecture.

CTENOCHÆTUS Gill.

Ctenodon Swainson, Nat. Hist. Fish, II, 256, 1839 (*strigosus*); name preoccupied.
Ctenochætus Gill, Proc. U. S. Nat. Mus., 1884, 277 (*strigosus*).

This genus contains species with slender movable teeth, each dilated at the apex.

1206. Ctenochætus striatus (Quoy & Gaimard). *Palagi; Ponepone; Aau.* Hawaii; Samoa; Aneiteum; New Ireland; New Britain; New Guinea; Guam; Carolines; Tahiti; Raiatea; Faté; Rarotonga; Tubuai and Shortland I. (Seale).

Acanthurus striatus Quoy & Gaimard, Voy. Uranie, 373, 1824, **Guam**, larva.

Acanthurus strigosus Bennett, Zool. Journ., IV, 1828, 41, **Sandwich Is.** Cuvier & Valenciennes, Hist. Nat. Poiss., X, 243, 1835. Günther, Cat., III, 342, 1861, Sandwich Is. Günther, Fische der Südsee, IV, 116, taf. 79, figs. B and C, 1875, Sandwich Is. Seale, Bishop Museum, 1901, 109, Guam. Peters, Berl. Mon., 1876, 835, New Britain.

Acanth.rus (Ctenodon) strigosus, Steindachner, Denks. Ak. Wiss. Wien, LXX, 1900, 494, Honolulu.

Acanthurus ctenodon Cuvier & Valenciennes, Hist. Nat. Poiss., X, 241, pl. 289, **Caroline Is.** Günther, Cat., III, 342, Aneiteum, East Indies. Peters, l. c., New Britain, New Ireland.

This species is generally common throughout Oceania. We found it abundant both at Hawaii and Samoa. The faint spots about the head and the faint streaks along the sides disappear in spirits.

Life colors of a specimen from Apia, called *palagi*, blackish brown, unmarked; dorsal with very faint horizontal streaks of bluish and bronze; anal very obscurely marked in the same way; caudal deeply forked; no stripes on body.

Another specimen was exactly like *Hepatus atramentatus*, but the profile of the head was much more convex; many wavy blue and bronze stripes on a blackish ground.

COLOCOPUS Gill.

Colocopus Gill, Proc. U. S. Nat. Mus. 1884, 279 (*lambdurus*).

This genus differed from *Hepatus* in having but two or three soft rays in the ventral fins.

1207. Colocopus lambdurus Gill. New Britain; Kingsmill I.; New Guinea (Macleay); Mauritius.

Acanthurus hepatus Günther, Fische der Südsee, 115, taf. 75; not *Teuthis hepatus* Linnæus, which name properly belongs to the American species usually known as *cæruleus*. Peters, Berl. Mon. 1877, 835, New Britain.

Colocopus lambdurus Gill, Proc. U. S. Nat. Mus., 1884, 279 (after Günther), Kingsmill I., Mauritius.

ZEBRASOMA Swainson.

Zebrasoma Swainson, Nat. Hist. Anim., II, 256, 1839 (*velifer*).
Scopas Kner, Novara Fische, 1865, 212 (*scopas*).

This genus differs from *Hepatus* in the short spinous dorsal of 4 or 5 graduated spines; soft dorsal high; snout short, projecting at an angle.

1208. Zebrasoma flavescens (Bennett). *Samasama.* Hawaii; Marcus I.; Guam; New Guinea (Macleay).

Acanthurus flavescens Bennett, Zool. Journ., IV, 1828, 40, **Hawaii.**

Zebrasoma flavescens, Steindachner, Sitz. Ak. Wiss. Wien 1900, 493, Honolulu. Bryan & Herre, Bishop Museum, 1903, 234, Marcus I.

Acanthurus virgatus Vaillant & Sauvage, Ann. Sci. Nat., 1875, 283, **Honolulu.**

Acanthurus agana Seale, Bishop Museum, 1901, 110, **Guam.**

This species is rather common about the Hawaiian Islands, and is reported from Guam under the name of *Zebrasoma agana*. *Zebrasoma virgatum* must be the young of this species, with blue spots on the head and brown blue streaks and pale cross-shades on the body. The description differs from *Zebrasoma flavescens* as the young of *Zebrasoma rhombeum* differs from the adult.

This species apparently agrees with *Zebrasoma rhombeum* in all respects except color. Were it not for its geographical separation we should follow Günther in uniting *rhombeum* with *flavescens*. The two are in fact probably the same species, the name *flavescens* being the older.

1209. Zebrasoma rhombeum (Kittlitz). *Iliu; Ali palagi.* Samoa; Ulea; Fiji; Aneiteum; East Indies.

Acanthurus rhombeus Kittlitz, Senckenberg Museum, I, 1834, 196, pl. XIII, fig. 16.

Acanthurus scopas Cuvier & Valenciennes, Hist. Nat. Poiss., X, 245, pl. CCXC, 1835, **Ile de France, Ulea.** Bleeker, Nat. Tijds. Ned. Ind., 1851, 348. Guichenot, Sagra Hist. Cuba, 122, 1851, Cuba by error. Günther, Cat., III, 342 1861, Ceram, Sandwich Is., Aneiteum.

Acanthurus altivelis Cuvier & Valenciennes, op. cit., X, 249, 1835, **Ile de France.**

Acanthurus goramensis Cuvier & Valenciennes, op. cit., X, 1835, **Goram**, young.

This species ranges widely through the East Indies. We have 50 specimens from Apia and Pago Pago. The yellow form, called *flavescens*, we did not find in Samoa. The two forms, *flavescens* and *rhombeum*, are without much doubt color variations of one dichromatic species.

Life colors were noted in various specimens as follows:

(1) Specimen from Apia, called *iliu*. Dark olive, somewhat clouded (a curved light blue streak behind the eye, parallel with the golden iris, in young only); everywhere fine oblong light blue spots, smaller and sharply defined on side of head, not evident on snout nor along the back; larger below and behind; fins all plain olive-black, the pectoral lighter olive; caudal spine bluish white; a short oblique streak of light olive above pectoral.

(2) An older example with light blue wavy streaks on body, not spots; streak above pectoral light yellow and very conspicuous; no blue behind eye; pectoral scarcely olive.

(3) From Apia. Dark brown, grayish behind, with about 20 fine bluish white cross-streaks; a whitish lateral streak above pectoral; fins all dusky. Larger ones more sharply colored.

(4) From Pago Pago. Posterior half of body fuliginous, darkest behind and merging anteriorly into yellow-green with fine pale blue specks; olive-green above eyes; iris yellow.

(5) From Apia. Blackish; faint bluish horizontal lines over body as in *Hepatus lineolatus;* a yellowish white short band above pectoral; head unspotted; fins dark.

(6) Specimen from Pago Pago, called *iliu*. Blackish brown; head, breast, and shoulders everywhere covered with fine bluish white dots; body with horizontal wavy stripes of the same color, on a bronze-brown ground; fins dusky olive, unstriped; dorsal, anal, and caudal with a fine paler edge; pectoral dark orange, dusky above and below; a long whitish stripe above pectoral.

(7) One specimen was almost black, the spots very distinct, the stripes mostly obsolete; the yellowish white line reduced to a round bright yellow spot near gill-opening, wanting on the other side; iris pink red, not gray as usual.

1210. Zebrasoma rostratum (Günther). *Ali.* Tahiti; Samoa.

Acanthurus rostratus Günther, Fische der Südsee, 117, taf. 65, fig. B, **Tahiti.**

This species is close to *Zebrasoma rhombeum*, but the snout is longer, the fins rather higher, and the color almost black. We have two examples from Apia, a little smaller than Günther's type, and with the body deeper.

Life colors of a specimen called *iliu*, black, with brownish tinge; snout reticulate; a vertical bar behind pectoral golden olive, with blue cross streaks; a similar bar from beginning of dorsal across opercle and obliquely across breast; five blue stripes and four olive between; below pectoral obscurely reticulate, with bluish around dull olive spots; fins uncolored; caudal with narrow pale edge; caudal spine black, as are all fins.

1211. Zebrasoma veliferum (Bloch). *Lupo.* Hawaii; Samoa; Fiji; East Indies.

Acanthurus velifer Bloch, IX, 106, taf. 427, fig. 1, 1798.
Acanthurus blochii Bennett, Proc. Zool. Soc. 1835, 207.
Acanthurus hypselopterus Bleeker, Nat. Tijds. Ned. Ind., VI, 1854, 313, **Flores.** Günther, Fische der Südsee, 1875, 117, Fiji Is. Steindachner, Denks. Ak. Wiss. Wien, LXX, 1900, 494, pl. IV, fig. 1, Honolulu.
Zebrasoma hypselopterum Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (1903), 479, Honolulu. Snyder, Bull. U. S. Fish Comm., XXII, 1902 (1904), 533, Honolulu.

This species is rather common about Samoa, whence we secured four examples. It is even more frequent about Honolulu. Our largest example, about a foot long, corresponds very closely to Bloch's figure of *velifer*. The caudal is dark, and the body is crossed by many dark cross-streaks, which cross six or seven obscure dark cross-shades, the most distinct being the ocular and scapular bands. In younger examples the cross-streaks are fainter, and in still younger they are wanting. The face is spotted with pale and the six or seven dark cross-bands become more distinct. This form from 4 to 8 inches long represents *hypselopterum*. Still younger forms have the snout and caudal yellow. We have none which correspond exactly either to *desjardinii* or to *ruppellii*.

Life colors of a specimen from Pago Pago, violet-black with four distinct yellowish cross-bands (grayish in formalin); these and rest of body crossed by regular dark bronze streaks; broad black ocular band reaching base of ventrals; head before it with network of bluish white spots; another dark area from base of dorsal to front of anal; fins blackish; caudal with narrow pale edge; breast unspotted.

A specimen from Apia, called *lupo*, had the snout and forehead dark yellow; ocular streak black edged with gray; then a broader black band edged with gray; then four brown bands, yellow between, then the caudal peduncle black, the pale stripe before it narrow; tail yellow, grayish behind, thus seven dark bands; dorsal and anal dusky deep yellow, the dorsal with some spots behind; ventral golden.

ACANTHURUS Forskål.

(*Monoceros*, *Naso*, and *Naseus* of authors.)

1212. Acanthurus unicornis (Forskål). *Ili'ilia segi; Ume; Umelei.* Hawaii; Samoa; Aneiteum; Guam; Tahiti; Waigiu; New Guinea; Raiatea (Seale); East Indies; Japan.

This species, widely diffused through the tropical Pacific and varying excessively at various stages of growth, is common about Hawaii. At Samoa we found it rather scarce, but four specimens being obtained. The caudal spines are bluish on a pale ground, while those of *Acanthurus lituratus* are orange.

Life colors of a specimen from Apia, dark olive, brownish below, paler on tail; spines clear blue; dorsal light brown, with light bluish spots and a dark edge; caudal dusky, paler behind; anal clear orange-brown, with a row of pale blue spots at base, then two pale bluish stripes and a whitish edge; pectoral and ventral mottled orange-gray.

Another specimen from Apia was grayish black, the spines dark blue; caudal peduncle brown, paler; dorsal light orange, with oblique bluish streaks; caudal gray; anal light orange, with horizontal bluish streaks; head, pectoral and ventral gray.

1213. Acanthurus brevirostris (Cuvier & Valenciennes). Hawaii; Tahiti; Kingsmill I., New Guinea; Ile de France.

Naseus brevirostris Cuvier & Valenciennes, Hist. Nat. Poiss., x, 277, pl. 291, 1835, **East Indies, Ile de France, New Guinea.** Günther, Cat., III, 349, 1861. Günther, Fische der Südsee, 121, taf. 79, fig. A, 1875, Kingsmill I., Tahiti.

Acanthurus brevirostris Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (1903), 481, Honolulu. Snyder, Bull. U. S. Fish Comm., XXII, 1902 (1904), 534, Honolulu.

This species, rather common about Hawaii, was not found in Samoa.

1214. Acanthurus incipiens Jenkins. Hawaii; Samoa.

Acanthurus incipiens Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (1903), 480, **Honolulu.**

Two specimens were seen at Samoa, similar in form to Jenkins's type. One of these is plain blackish, the other covered with blue spots. The caudal fin in both is blackish. This fin is largely yellow in *Acanthurus brevirostris*, otherwise we might regard *Acanthurus incipiens* as the young of that species. It is apparently an immature form.

Life colors of one specimen from Apia, black, with a brownish shade; upper parts with small rounded spots of deep violet-blue; belly paler, slaty; lips blue; a blue streak below eye; dorsal dark brown, slightly bluish on spines, dusky on edge; ventral dark brown, paler behind, the edge blackish; anal dark brown with two dark blue streaks and a dusky edge; ventral and pectoral dark brown; caudal black with a faint trace of a pale edge. No trace of horn or of spines on tail. Length, 6 inches.

1215. Acanthurus annulatus (Quoy & Gaimard). Tonga; Palau; Aneiteum; Fiji; Guam.

Priodon annulatus Quoy & Gaimard, Voy. Uranie, 377, 1824, **Polynesia**, young. Seale, Bishop Museum, 1901, 113, Guam.

Naseus marginatus Cuvier & Valenciennes, Hist. Nat. Poiss., x, 290, 1835, Tonga; not *Acanthurus marginatus* Kittlitz. Gunther, Fische der Sudsee, 122, Palau, Aneiteum.

Monoceros marginatus Seale, Bishop Museum 1901, 114, Guam.

Priodon annularis Cuvier & Valenciennes, Hist. Nat. Poiss., x, 302, pl. 294, 1835, **Guam**, young.

1216. Acanthurus tuberosus Lacépède. Guam; Aneiteum; New Guinea; Mauritius.

Naso tuberosus Lacépède, Hist. Nat. Poiss., III, 111, 1802, **Ile de France.**

Naseus tuberosus, Gunther, Fische der Sudsee, 123, Aneiteum, Ceylon, Zanzibar, Mauritius.

Acanthurus nasus Shaw, Gen. Zool., v, 376, pl. 51, 1803. **Ile de France.**

Naseus carolinarum[a] Quoy & Gaimard, Voy. Uranie, 375, pl. 63, fig. 1, 1824, Guam.

Naseus tuber Cuvier & Valenciennes, Hist. Nat. Poiss., x, 290, 1835, **Ile de France.**

Naseus tonganus Quoy & Gaimard, in Cuvier & Valenciennes, Hist. Nat. Poiss., x, 292, 1835, Tonga; specimen immaculate.

Naseus punctulatus Steindachner, 1874.

This species we have not seen. It is probably rare in Polynesia.

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[a] This species, marked by green blotches, is imperfectly described, and has not been recognized by recent authors. It is perhaps nearest *Acanthurus tuberosus*.

1217. Acanthurus metoposophron (Jenkins). Hawaii.

Callicanthus metoposophron, Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (1903), 481, fig. 31, **Honolulu.**

1218. Acanthurus vlamingi (Cuvier & Valenciennes). Marshall Is.; Aneiteum; East Indies.

Naseus vlamingi Cuvier & Valenciennes, Hist. Nat. Poiss., X, 293, 1835, **Moluccas.** Günther, Fische der Südsee, 123, Ebon, Marshall Is., Aneiteum, Ceram. Fowler, Proc. Ac. Nat. Sci. Phila., 1899, 193, South Seas.

1219. Acanthurus lituratus (Forster). *Ili'ilia; Umelei; Ume.* Tahiti; Hawaii; Samoa; Johnston I.; Guam; New Guinea; East Indies.

Acanthurus lituratus Forster, in Bloch & Schneider, Syst. Ich. 1801, 218, **Tahiti.**
Harpurus lituratus Forster, Descr. Anim., 218, 1844, Tahiti.
Naseus lituratus, Günther, Fische der Südsee, 124 (with plate representing "*garretti*"), Sandwich Is., Tahiti, Red Sea.
Monoceros lituratus Seale, Bishop Museum 1901, 112, Guam.
Aspisurus elegans Rüppell, Atlas, Fische, 61, tab. XVI, fig. 2, 1828, **Red Sea.**
Priodurus coume Lesson, Voy. Coquille, II, 151, 1830, **Tahiti.**
Naseus lituratus Smith & Swain, Proc. U. S. Nat. Mus. 1882, 139, Johnston I. Steindachner, Sitz. Ak. Wiss. Wien 1900, 495, Honolulu.
? *Monocerus garretti* Seale, Bishop Museum 1901, 112, **Guam.**

This species is common at Samoa, as about Hawaii. In both places, and almost equally abundant, occurs the form described as *Monoceros garretti.* The only permanent difference seems to be this—in the true *lituratus* there is a line of clear blue along the base of the dorsal, and in *garretti*, old and young, this is wanting. As we find no other difference, the senior author is very doubtful as to whether *Acanthurus garretti* is a valid species.

Life colors were noted in various specimens as follows:

(1) Specimen from Apia called *ume.* Dark olive, brownish below, paler on tail; spines clear blue; dorsal light brown, with light bluish spots and a dark edge; caudal dusky paler behind; anal clear orange-brown, with a row of pale blue spots at base, then two pale bluish stripes and a whitish edge; pectoral and ventral mottled orange-gray.

(2) From Apia (young of preceding?). Dusky olive; belly yellowish brown; lips yellowish brown; a blue streak along base of dorsal, which is black except for a long white stripe; caudal dark olive, edged with greenish, then white; anal dull orange, edged with black; two anal spines dull orange; ventral dull orange.

(3) Specimen called *umelei*, *ume*, also from Apia. Grayish black, the spines dark blue; caudal peduncle brown, paler; dorsal light orange with oblique bluish streaks; caudal gray; anal light orange, with horizontal bluish streaks; head, pectoral, and ventral gray.

(4) Specimen from Apia called *umelei.* Dusky grayish, yellowish above eye; a bluish streak along base of dorsal; caudal whitish behind; dorsal and anal deep maroon red and dusky.

(5) Specimen called *ili'ilia.* Black, brownish tinged; dorsal black, a pale blue streak at base, the edge gray with black margin and a row of bluish spots; spines orange; caudal black, with broad white edge; anal orange, black and white on margin, olive green at base; ventral olive orange; pectoral black; lips brown, a light yellow-brown streak from eye.

1220. Acanthurus garretti (Seale). Guam; Hawaii; Samoa.

Monoceros garretti Seale, Bishop Museum, 1901, 112, **Guam.**

This species, if such it be, is distinguished from *Acanthurus lituratus* by the absence of a blue line along the base of the dorsal and by the yellow spots on caudal peduncle separated by sharply defined black area. It is found at Hawaii and Samoa with *Acanthurus lituratus.* It is represented in Günther's plate of *Naseus lituratus* in Fische der Südsee. It is probably a color variation of *Acanthurus lituratus*—a view not shared by the junior author, however.

AXINURUS Cuvier & Valenciennes.

1221. Axinurus thynnoides Cuvier & Valenciennes. New Guinea; East Indies.

Family SIGANIDÆ.

SIGANUS Forskål. *Lo.*

1222. Siganus marmoratus (Quoy & Gaimard). *Lo pa'u'ulu.* Samoa; Fiji; Guam; New Hanover; New Britain; Tahiti; East Indies.

Amphacanthus marmoratus Quoy & Gaimard, Voy. Uranie, Zool., 367, 1824, **Guam.**
Teuthis marmoratus Günther, Fische der Südsee, 93, Caroline Is. Peters, Berl. Mon., 1876, 835, Amboina, New Hanover, New Britain.
Siganas marmoratus Seale, Bishop Museum 1901, 111, Guam.
Amphacanthus guamensis Cuvier & Valenciennes, Hist. Nat. Poiss., x, 163, 1835, **Guam.**
Amphacanthus scaroides Bleeker, Nat. Tijds., 853, 262, **East Indies.**
Teuthis striolata Günther, Fische der Südsee, taf. LIX, fig. A (not description), **Samoa, Tahiti.**

This species is very common about Samoa. We have 40 specimens from Apia and Pago Pago.

It is possible that the specimens called *Teuthis striolata* by Günther, from Samoa, belong to this species, which is very close to *Siganus striolatus*, the body a little deeper than in the latter. Günther's figure of *striolatus* is much like *Siganus marmoratus* except that the body in the latter is deeper and the fins more sharply banded. In the type of *striolatus* the fins are said to be immaculate.

Life colors of a specimen from Apia called *lo*, olive green above, livid gray below; vermiculations of bluish gray around dark olive; fins similar, browner, also vermiculated or blotched.

1223. Siganus nebulosus (Quoy & Gaimard). Guam; East Indies.

Amphacanthus nebulosus Quoy & Gaimard, Voy. Uranie, 1824, 369, **Timor, Guam, Port Jackson.**
Amphacanthus maculosus Quoy & Gaimard, op. cit., 370.

This mottled species we have not seen, and it may not belong to the South Seas. Probably the specimens from Guam belong to *Siganus marmoratus.*

1224. Siganus striolatus (Günther). Samoa (Günther); New Hebrides; Solomon Is.; Tonga; Tahiti; Raiatea (Seale).

Teuthis striolata Günther, Cat., III, 319, 1861, **New Hebrides.** Günther, Fische der Südsee, 89, New Hebrides, Solomon Is., Samoa, Tonga, Tahiti.

This species is unknown to us.

1225. Siganus concatenatus (Cuvier & Valenciennes). Kusai; Palau Is.; East Indies.

Amphacanthus concatenatus Cuvier & Valenciennes, Hist. Nat. Poiss., x, 127, 1835, **Buru, Java.**
Teuthis concatenatus, Günther, Fische der Südsee, 88, Palau Is., East Indies. Günther, Challenger, Shore Fishes, 46, 1880, Admiralty Is.

Not found in Samoa. We have a specimen from Kusai, Caroline Islands, collected by Mr. A. P. Lundin.

1226. Siganus vermiculatus (Cuvier & Valenciennes). Admiralty Is.; New Guinea; Shortland I. (Seale); East Indies.

Amphacanthus vermiculatus Cuvier & Valenciennes, Hist. Nat. Poiss., x, 126, 1835, **New Guinea, Java, Ile de France.**
Teuthis vermiculatus, Günther, Challenger, Shore Fishes, 1880, 46, Admiralty Is.

1227. Siganus puellus (Schlegel). Apamana; Gilbert Is.; Palau Is.; East Indies.

Amphacanthus puellus Schlegel, Bydr., 1852, 39, **East Indies.**
Teuthis puellus, Günther, Fische der Südsee, 91, Apamana, Palau.

1228. Siganus doliatus (Cuvier). Vanicolo; Fiji; Ponape; Palau Is.; New Hebrides; New Britain; Raiatea (Seale); East Indies.

Amphacanthus doliatus Cuvier & Valenciennes, Hist. Nat. Poiss., x, 182, 1835, Buru, Vanicolo.
Teuthis doliatus, Günther, Fische der Südsee, 96, New Hebrides, Fiji, Palau, Ponape. Kner, Novara Fische, 209, Ponape. Peters, Berl. Mon., 1876, 835, New Britain.

1229. Siganus lineatus (Cuvier & Valenciennes). Vanicolo; New Guinea.

1230. Siganus fuscescens (Houttuyn). Palau Is.; Howland I. (Günther); Marcus I. (Bryan & Herre); Japan.

Siganus doliatus Cuvier, Regne Animal.
Centrogaster fuscescens Houttuyn, Mem de Haerl., xx, 333, **Nagasaki.**
Amphacanthus albopunctatus Schlegel.

This species, characteristic of southern Japan, is recorded from the South Seas, but was not found by us.

1231. Siganus argenteus (Quoy & Gaimard). Guam.

Amphacanthus argenteus Quoy & Gaimard, Voy. Uranie, Zool., 368, 1824, **Guam.**
Teuthis argentea Günther, Fische der Südsee, 90, locality unknown.

1232. Siganus canaliculatus (Park). Vanicolo; New Britain; East Indies.

Chætodon canaliculatus Mungo Park, Trans. Linn. Soc., III, 1797, 473, **Sumatra.**
Amphacanthus margaritiferus Cuvier & Valenciennes, Hist. Nat. Poiss., x, 145, 1835, **Amboina, Vanicolo.**
Teuthis margaritiferus, Peters, Berl. Mon. 1876, 835, New Britain. Günther, Challenger Shore Fishes, 46, 1880, Admiralty Is.

1233. Siganus vitianus (Sauvage). Fiji.

Teuthis vitianus Sauvage, Bull. Phil. Soc., VI, 173; **Fiji.**

1234. Siganus oligostictus (Kner). Fiji.

Teuthis oligostictus Kner, Sitz. Ak. Wiss. Wien 1868, 30, **Fiji.**

1235. Siganus punctatus (Bloch & Schneider). *Lo 'ele'ele.* Tonga; New Caledonia; Guam; Fiji; Samoa; East Indies.

Amphacanthus punctatus Bloch & Schneider, Syst. Ichth., 1801, 210, **Pacific Ocean (Tonga, New Caledonia).**
Siganus hexagonatus Bleeker, Nat. Tijds. Ned. Ind., VII, 1854, 41, **East Indies.** Seale, Bishop Museum 1901, 111, III, Guam.
Teuthis hexagonata, Günther, Fische der Südsee, 80, Fiji, Samoa.

This species is abundant at Samoa. We have about 10 specimens from Apia and Pago Pago. This is certainly the species called *hexagonatus* by Bleeker, and it is without much doubt the *punctatus* of Bloch and Schneider, as Forster's notes, copied by Schneider, indicate a compressed species with small yellow spots on a bluish ground. Kner (Novara Fische) records some similar species as *Amphacanthus guttatus* Bloch from Java and Ponape, but the *Amphacanthus guttatus* of Bloch and Schneider is another species of *Siganus.*

Life colors of a specimen from Apia called *elieli*, deep dusky blue, the color forming a network around bronze orange spots; vertical fins marked in like fashion, but duller; pectoral olive; ventral blackish gray. Body deeper than in *Siganus rostratus.*

1236. Siganus rostratus (Cuvier & Valenciennes). Palau; Tahiti; Guam; Samoa; Gilbert Is.; Raiatea; Tubuai; Fate and Shortland I. (Seale); Zanzibar.

Amphacanthus rostratus (Cuvier & Valenciennes), Hist. Nat. Poiss., x, 158, 1835, **Red Sea.**
Teuthis rostratus Günther, Fische der Südsee, 89, with plate, Palau, Tahiti, Gilbert Is., Zanzibar.
Siganus rostratus, Seale, Bishop Museum 1901, 112, Guam.

This species is colored very much like *Siganus punctatus*, but the body is more elongate, the caudal fin still more deeply forked. We have four large specimens from Apia.

Life colors of one of these, sky-blue, dark above, vermiculated with golden; dorsal mottled olive; caudal dusky, paler behind; anal dusky; ventral gray, barred with dark olive; pectoral golden.

1237. Siganus corallinus (Cuvier & Valenciennes). Palau Is.; East Indies.

Amphacanthus corallinus Cuvier & Valenciennes, Hist. Nat. Poiss., x, 139, 1835, **Seychelles, East Indies.**
Teuthis corallinus, Günther, Fische der Südsee, 88, Palau.

1238. Siganus studeri (Peters). New Britain.

Teuthis studeri Peters, Berl. Mon. 1876, 834, **New Britain.**

LO Seale, new genus.

Lo Seale, new genus of *Siganidæ* (type *Amphacanthus vulpinus* Schlegel & Müller).

This genus is defined by the short tubular snout. *Lo* is the vernacular name applied to all the *Siganidæ* in Samoa.

1239. Lo vulpinus (Schlegel & Müller). Solomon Is.; Palau Is.; Alu, Solomon Is. (Seale); East Indies.

Amphacanthus vulpinus Schlegel & Müller, Bydr. Dierk., v. 1852, 38, **East Indies.**

Teuthis vulpinus, Günther, Fische der Südsee, 91, Solomon Is., Palau Is.

This species, distinguished by the deep body, the slender elongate snout, and the peculiar coloration, is known to us from one specimen, brought by Mr. Seale from Alu, one of the Solomon Islands. We present a figure taken from this specimen, together with Mr. Seale's notes upon it.

Head 3.3 in length; depth 2.2; eye 4 in head; interorbital equal to eye; snout 2 in head; scales minute; dorsal XIII, 10; anal VII, 9; ventral I-3-I.

Body compressed, snout produced, mouth small; a single row of small flat teeth fixed in each jaw, 12 on each side; opercle striate; none of the dorsal or anal spines greatly elongate; the dorsal spines, excepting the short anterior one, of about equal length, the longest 2 in head; anal spines similar, the longest 2; soft rays of dorsal, 1.75; ventral 1.4; caudal emarginate, the lobes rounded; caudal peduncle short, its depth equal to eye.

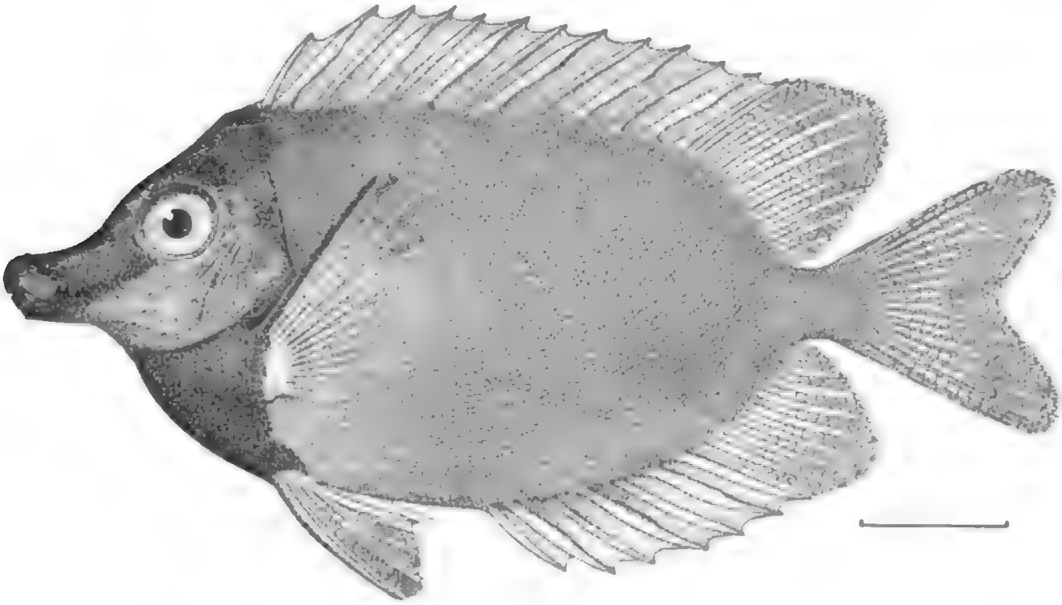

FIG. 67.—*Lo vulpinus* (Schlegel & Müller).

Color in life, light bister brown; thorax and first ray of pectoral deep black; head and shoulders a deeper brown than the body; caudal, dorsal, and anal orange; spines of ventral and the first ray dusky; pectoral yellowish, with a slight dusky wash.

Color in spirits, dull grayish brown, thorax and head much darker; anterior ray of pectoral black; fins yellowish white.

One specimen (no. 1325 Bishop Museum) from Alu, one of the Solomon Islands, length, 7 inches.

Family BALISTIDÆ.

BALISTES (Artedi) Linnæus. *Sumu.*

1240. Balistes vidua Richardson. *Sumu pa'epa'e mumu; Sumu i'u mumu.* Hawaii; Samoa; Nukahiva (Seale).

Life colors of a specimen from Pago Pago called *sumu pa'epa'e mumu*, body dark smoky, paling a little below; pectoral canary-yellow with black edge; dorsal white with black margin; anal same; caudal Chinese white at base, the rest scarlet.

1241. **Balistes castaneus** Richardson. Pacific; west coast of Mexico.

Balistes castaneus Richardson, Voy. Sulphur, 126, pl. 59, figs. 5, 6, **Pacific, locality unkown.** Regan, Ann. Nat. Hist. 1902, 297, Pacific, same specimen.

Balistes polylepis Steindachner, Ich. Beitr., v, 21, 1876, **Magdalena Bay, Masatlan, Acapulco.** Jordan & Evermann, Fishes North & Mid. Amer., II, 1700, 1898, Lower California, Panama.

According to Regan's account this is a true *Balistes*, and agrees very closely with *Balistes polylepis* Steindachner, a species common from Cerros Island to Panama. We have also a specimen from San Diego. Richardson's specimens probably came from the Panama region, and it is likely that the species does not belong to the Polynesian fauna at all.

1242. **Balistes capistratus** Shaw. Hawaii; Nukahiva (Seale); East Indies.

1243. **Balistes niger** Bonnaterre. New Guinea; East Indies.

(*Balistes conspicillum* Bloch & Schneider.)

1244. **Balistes bursa** Bloch & Schneider. Hawaii; Nukahiva (Seale); East Indies.

1245. **Balistes viridescens** Bloch & Schneider. New Guinea (Macleay); East Indies.

1246. **Balistes nycteris** Jordan & Evermann. Hawaii.

1247. **Balistes chrysopterus** Bloch & Schneider. *Sumu pa'epa'e.* Samoa; Aneiteum; Micronesia; New Britain; Faté (Seale).

Balistes niger Mungo Park, Trans. Linn. Soc., III, 37, 1791, **Sumatra**; not of Bonnaterre, 1788, which is *Balistes niger = Balistes conspicillum*. Günther, Cat., VIII, 218, Red Sea, Mauritius, Ceylon, Sumatra, Amboina, Aneiteum, Micronesia, Zanzibar. Day, Fish Ind., 688, pl. 181, fig. 1, Malaysia. Peters, Berl. Mon. 1876, 852; New Britain.

Balistes armé Lacépède, Hist. Nat. Poiss., I, 336, 382, 1798.

Balistes chrysopterus Bloch & Schneider, Syst. Ichth., 466, 1801, **Coromandel.**

Balistes mungopark Lacépède, Hist. Nat., Poiss., IV, 682, 1803; after Park.

Balistes subarmatus Gray & Hardwicke, Ill. Ind. Zool., **India.**

Balistes albicaudatus Rüppell, Neue Wirbelthiere, 54, XVI, fig. 1, 1835, **Red Sea.**

Balistes verrucosus Gronow, Syst., ed. Gray, 33, 1854; not of Bonnaterre.

Balistes armatus, Bleeker, Atlas, v, 115, tab. CCXVI, East Indies; name after Lacépède.

Of this East Indian species we obtained two specimens at Samoa, where it is apparently rare. Life colors of a specimen from Apia called *pae pae*, olive-gray, without color, whitish about jaws; a whitish band across lower jaw, another across chin, the latter extending backward across lower part of cheek; caudal gray with a blackish cross-streak and a white crescent at edge.

1248. **Balistes fuscolineatus** Seale. Hawaii.

1249. **Balistes fuscus** Bloch & Schneider. Fiji (Günther); Tahiti (Seale); New Guinea (Macleay); East Indies.

1250. **Balistes flavomarginatus** Rüppell. *Sumu laolao.* Samoa; New Britain (Peters); New Guinea (Macleay); Shortland I. (Seale); East Indies; Japan.

A single large specimen of this East Indian species was taken at Apia. It agrees closely with Bleeker's figure. According to Dr. Peters, this is the *Balistes brasiliensis* of Bloch and Schneider. The description of Schneider agrees fairly, but it is confused with some of the American species and purports to be drawn from an American specimen.

Life colors of a specimen from Apia called *sumu laolao*, light olive-green, the head abruptly creamy reddish brown, sides with many blackish spots covering or partly covering individual scales; back more brownish; first dorsal brownish with dusky membrane; second dorsal dusky brownish at base with orange-brown edge; anal same; caudal orange-brown, deeper on edges and margin with a dusky crescent; pectoral pale orange; naked "grooves" on cheek raised, reddish brown, the scaly stripes darker.

BALISTAPUS Tilesius.

1251. **Balistapus aculeatus** (Linnæus). *Sumu uliuli.* Hawaii; Samoa; Johnston I.; Fiji; Guam; New Guinea; Marcus I.; New Ireland; East Indies.

Monacanthus chirerti Alleyne & Macleay, Proc. Linn. Soc. N. S. W., 1876, 355, **New Guinea.**

Balistes aculeatus Steindachner, Sitz. Ak. Wiss. Wien, 1900, 517, Samoa, Laysan. Peters, Berl. Mon. 1876, 852, New Ireland. Swain & Smith, Proc. U. S. Nat. Mus., v. 1882, 139, Johnston I. Seale, Bishop Museum 1901, 115, Guam. Bryan & Herre, Bishop Museum 1903, 135, Marcus I.

This handsome species is generally common at Honolulu and Samoa, thence throughout the South Seas and East Indies.

1252. **Balistapus rectangulus** (Bloch & Schneider). *Sumu pulepule.* Hawaii; Guam; Marcus I.; Samoa; New Guinea; Faté and Nukuhiva (Seale).

This pretty species is rather common about Hawaii, thence through the South Seas and East Indies. We have a few specimens from Samoa.

1253. **Balistapus undulatus** (Bloch & Schneider). *Sumu uli.* Samoa; New Britain; New Guinea; New Hanover; Guam; Tahiti; Shortland I., Faté and Raiatea (Seale); East Indies.

Of this common East Indian species we have about a hundred specimens from the reefs of Samoa, where it is very abundant. It was not seen at Honolulu.

Life colors of a specimen from Apia called *sumu uli*, deep livid olive green, shaded on back and head; stripes anteriorly, scarlet on chin, yellow on lower lip; body covered by oblique stripes running forward and backward; brassy orange on head; violet streaks on snout and side of head; golden brown stripes on side; first dorsal golden, with blue spots; second dorsal golden, orange at base, violet blue lower, the membranes bluish; caudal centrally yellow-orange, with violet stripes on margin; anal like dorsal; a black patch on caudal peduncle; pectoral scarlet, black at base, pale at tip.

1254. **Balistapus oire** (Bennett). Raiatea; Tahiti.

Balistes oire Bennett, Whaling Voyage, II, 262, 1840, **Raiatea, Tahiti.**

1255. **Balistapus papuensis** (Macleay). New Guinea.

Balistes papuensis Macleay, Proc. Linn. Soc. N. S. W. 1884, 279.

1256. **Balistapus verrucosus** (Linnæus). New Ireland; New Guinea; Shortland I. (Seale); East Indies.

CANTHIDERMIS Swainson.

1257. **Canthidermis rotundatus** (Procé). South Seas?; Philippines; East Indies.

1258. **Canthidermis angulosus** (Quoy & Gaimard). Hawaii (Quoy & Gaimard); Laysan; Galapagos Is. (Snodgrass & Heller); East Indies.

Balistes angulosus Quoy & Gaimard, Voy. Uranie, Zool. 210, 1821, **Maui.** (Dorsal 23, anal 20. Color black, fins high.) *Balistes aureolus.* Richardson, Voy. Sulphur, Fishes, 126, pl. 59, fig. 1, 2, East Indies. Günther, Cat., VIII, 215, 1870, young, East Indies. Steindachner, Sitz. Ak. Wiss. Wien 1900, 317, Laysan.

Of this species we know the published descriptions only, and these do not distinguish it from *Canthidermis rotundatus*. *Balistes aureolus*, from the East Indies, based on young examples, is said to differ from *Canthidermis rotundatus* in the larger scales. *Balistes willughbei* Bennett from Mazatlan and *Balistes adspersus* Tschudi from Peru belong in this neighborhood.

In all our explorations we have taken no species of *Canthidermis* in the Pacific.

XANTHICHTHYS Richardson.

1259. **Xanthichthys lineopunctatus** (Hollard). Hawaii; Revillagigedo Is.; Bourbon I.

(*Xanthichthys mento* Jordan & Gilbert.)

This species, not rare in rather deep water about volcanic rocks in the neighborhood of Hawaii, was not seen in Samoa. It occurs among the Revillagigedo Islands off the coast of Mexico, and at Laysan. The West Indian species, *Xanthichthys ringens*, is probably different, but the species called *Balistes lineopunctatus* by Hollard, based on an example from Bourbon Island, is apparently the Hawaii-Mexican species.

1260. **Xanthichthys rivulatus** (Rüppell). Faté, New Hebrides (Seale); Red Sea.

MELICHTHYS Swainson.

1261. **Melichthys radula** Richardson. Hawaii; Marcus I.; Johnston I.; Laysan; offshore islands of Mexico.

(*Melichthys bispinosus* Gilbert.)

ABALISTES Jordan & Seale, new generic name.

Abalistes Jordan & Seale, new generic name in *Balistidæ* (*stellaris*).

Leiurus Swainson, Nat. Hist. Fish., II, 326, 1839 (*L. macrophthalmus*); not of Swainson, op. cit., 242, which is *Gasterosteus.*

This strongly marked genus is known at once by the depressed tail. The name *Leiurus*, first used for a stickleback, is not available for it.

1262. **Abalistes stellaris** (Bloch & Schneider). Fiji (Günther), Louisiades (Günther); Australia; East Indies.

Family MONACANTHIDÆ.

CANTHERINES Swainson.

1263. **Cantherines sandwichensis** (Quoy & Gaimard). *Aimeo* Hawaii; Samoa; Guam (Seale); East Indies; Clarion I.

Of this species, common at Hawaii and on the offshore islands of Mexico, we have three specimens from Apia and one from Pago Pago. All specimens from Hawaii and Mexico and Samoa are uniformly dark colored, none showing the network of pale lines about dark spots characteristic of the East Indian variety called *pardalis.* Of the Samoan species, one is covered with a network of brown lines arranged honeycomb fashion, while the others are plain. The West Indian species *Cantherines pullus* is very similar to *Cantherines sandwichensis.* In any event the last-mentioned name must stand, being prior to all others.

Life colors of a specimen from Apia, rich purple-black, unmarked; pectoral, second dorsal, and anal golden; first dorsal and caudal black; lips black.

Another specimen from Apia was dark gray, reticulate with olive brown; second dorsal and anal light yellow, with a bluish streak along the base; caudal dirty yellow. Spine unserrated; ventral spine immovable.

1264. **Cantherines albopunctatus**[a] (Seale). Hawaii; Tahiti.

? *Monacanthus howensis* Ogilby, Rec. Austr. Mus., 1889, **Lord Howe I.** Waite, Austr. Mus., 1901, pl. VIII, Lord Howe I.

Monacanthus albopunctatus Seale, Occ. Papers Bishop Museum, vol. I, no. 4, 13, fig. 6, **Honolulu.**

Pseudomonacanthus multimaculates Regan, Ann. Nat. Hist., 1902, 299, with plate, Tahiti.

Cantherines albopunctatus Jordan & Evermann, Bull. U. S. Fish Comm., XXIII, 1903 (1905), 420, Hawaii.

This species is very close to *Cantherines howensis* described by Ogilby and figured by Waite from Lord Howe Island. That species has, however, but 33 dorsal rays, while *albopunctatus*, with the same form and color, is said to have 38.

1265. **Cantherines punctulatus** (Regan). Tahiti.

Pseudomonacanthus punctulatus Regan, Ann. Nat. Hist., 1902, 298, with plate, **Tahiti.**

1266. **Cantherines armatus** (Garman). Fiji.

Alutera armata Garman, Bull. Mus. Comp. Zool., 1903, Fiji.

This species we have not seen. It is apparently well distinguished by the numerous (over 40) soft rays in the dorsal and anal. Ventral spine immovable; dorsal spine barbed.

1267. **Cantherines nigricans** (Macleay). New Guinea.

Monacanthus nigricans Macleay, Proc. Linn. Soc. N. S. W. 1883, 596.

1268. **Cantherines fuliginosus** (Macleay). New Guinea.

Monacanthus fuliginosus Macleay, op. cit., 596.

AMANSES Gray.

Amanses Gray, Indian Zoology, 1830 (*hystrix*).

Trichoderma Swainson, Nat. Hist. Fish., II, 1839 ("*scapus*").

In the males of this genus there is a sheaf of long needle-like spines, about ten in number and nearly as long as the head on each side of the tail. In the female a brush of shorter spines takes the place of these. In other regards the genus is close to *Cantherines.*

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[a] This species and the next two, having the dorsal spine serrate, belong to the subgenus *Pseudomonacanthus.*

1269. Amanses scopas (Cuvier). *Sisitui.* Samoa; New Guinea (Macleay); East Indies.

Of this singular species we have four fine examples from Apia, the first recorded from Polynesia. Life colors of a specimen called *sisitui*, dark brown, a little paler below, a little darker on head and tail; dorsal anal and pectoral colorless, the rays olive, with some bluish on membranes, caudal black; spines of side black at base.

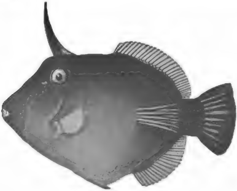


FIG. 68.—*Amanses scopas* (Cuvier).

OXYMONACANTHUS Bleeker.

This genus is near *Cantherines*, from which it differs in the elongate form and very long, sharp snout. Unlike the other filefishes, the single species of this genus is gaudily colored.

1270. Oxymonacanthus longirostris (Bloch & Schneider). *Alera.* Samoa; Guam; Fiji; New Caledonia; East Indies. (Pl. L, fig. 2.)

Of this fantastic little fish we have about 15 specimens, none over 3 inches long, from the reefs of Apia and Pago Pago. Life colors of one from Apia, sky blue with rows of bright orange spots; ventral flap orange; a brown area above it with fine white dots; fins pale; dorsal and anal reddish, the caudal yellowish brown with two faint broad cross shades; breast light green.

CHÆTODERMIS Bleeker.

1271. Chætodermis penicilligerus (Cuvier). New Guinea; East Indies; Australia.

MONACANTHUS Cuvier.

This genus is characterized by the movable ventral spine. In most of the species the ventral flap is moderate, and the dorsal spine serrated. These belong to the subgenus *Stephanolepis*, which differs from *Monacanthus* only in the reduction of the ventral flap, a character of slight importance.

1272. Monacanthus chinensis (Bloch). New Guinea (Macleay); East Indies; China.

1273. Monacanthus melanocephalus Bleeker. *Pa'u-mea; Moloasi.* Samoa; New Guinea (Macleay); East Indies.

Monacanthus melanocephalus Bleeker, Nat. Tijds. Ned. Ind., v, 96, East Indies. Bleeker, Atlas, v, 127, tab. CCXXIII, fig. 1, East Indies. Günther, Cat., VIII, 242; from Bleeker's type.
Monacanthus janthinosoma Bleeker, Nat. Tijds. Ned. Ind., VI, 503, **East Indies.**
Monacanthus aspricaudus Hollard, Ann. Sci. Nat. 1854, II, 530, **Batavia.**

Of this well-marked species we obtained about a dozen specimens from Apia and one from Pago Pago, the first record in Polynesia. It reaches a small size, and is known at once by the checkered band at the end of the caudal fin. The dorsal and anal fins are checkered with black, but these markings are faint in the young. The gill-opening lies in a dark bar

Life colors of a specimen from Apia called *pa'u-mea*, dull blackish green, black around gill-opening; bluish around vent; membrane of first dorsal spine bright orange, soft dorsal and anal finely mottled blue and orange; edges translucent; caudal bright orange with round yellow spots, the edge with four alternating wavy streaks of blue and orange; side of abdominal cavity livid bluish.

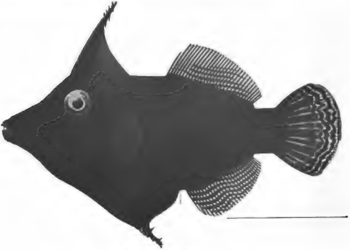


FIG. 69.—*Monacanthus melanocephalus* Bleeker.

Another specimen has the sides very finely marked with wavy blue streaks, most distinct on bluish lower parts, but very faint; dorsal membrane dull yellow; blue and orange streaks on dorsal more evident; ventral flap blackish.

1274. Monacanthus spilosomus Bennett. Hawaii.

1275. Monacanthus pricei Snyder. Kauai I., Hawaii.

1276. Monacanthus nitens Hollard. Tonga.

This species is unknown to us. It has the dorsal rays 30; anal 24; and the color is brownish without distinct spots or stripes. The dorsal spine is serrated, and the armature of the ventral spine is very strong. The spine, being large, is probably movable, but this is not stated. The species probably belongs to the section *Stephanolepis* of *Monacanthus*.

1277. Monacanthus filicauda Günther. New Guinea.

Monacanthus filicauda Gunther, Challenger Report, Fishes, 50, 1880.

PARALUTERES Bleeker.

1278. Paraluteres prionurus (Bleeker). New Guinea; East Indies.

OSBECKIA Jordan & Evermann.

1279. Osbeckia scripta (Osbeck). Hawaii; New Guinea (Macleay); East Indies; west coast islands of Mexico.

1280. Osbeckia lituroſa (Shaw). Tahiti.

Balistes liturosus Shaw, Gen. Zool., v, 406, 1803, **Tahiti.**
Monacanthus liturosus, Günther, Cat., VIII, 253; copied.

This species was probably founded on a large example of *Osbeckia scripta.*

ALUTERA (Cuvier) Oken.

1281. Alutera monoceros (Linnæus). Hawaii; New Guinea (Macleay); East Indies.

Family OSTRACIIDÆ.

OSTRACION Linnæus.

1282. Ostracion tuberculatum Linnæus. *Moamoa uli.* Samoa; Fiji; Guam; New Guinea; Marcus I.; New Britain (Peters: Berl. Mon. 1876, 852); East Indies.

This species, known by the round blue-black spots, is moderately common about Samoa. We have six specimens from Apia and Pago Pago. One of these was yellow in life, the others olive. This species seems well separated from its Japanese cognate, *Ostracion immaculatum.* The species, called *Ostracion trigonum* and *Ostracion cubicum*, is identical with *Ostracion tuberculatum.*

Life colors of a specimen from Apia called *moamoa*, dark olive brown with bluish spots, which are white in spirits; fins dull golden, blackish at base; caudal with a few rounded black spots at base.

All the specimens from Pago Pago had blue-black spots; one with the caudal deep orange yellow, the other fins paler yellow; another with the caudal dusky shaded with light yellow, the other fins bright yellow.

1283. Ostracion nasus Bloch. Guam; East Indies.

1284. Ostracion ornatum Hollard. Marquesas Is.

Ostracion ornatus Hollard, Ann. Sci. Nat., VII, 1857, 166, **Marquesas Is.**

This well-marked species, distinguished by the two pale lateral stripes, is unknown to us.

1285. Ostracion lentiginosum Bloch & Schneider. *Moamoa uliuli.* Hawaii; Samoa; Guam; Johnston I.; East Indies.

This species, common in the East Indies and South Seas, occurs both in Hawaii and Samoa. We have eight examples from Apia and Pago Pago. The color is plain dark olive, with small whitish spots above, below, and on sides.

Life colors of a specimen from Apia, blackish brown, spotted everywhere with grayish white, marbled on orange shades; caudal and belly also spotted; other fins olive; dorsal blackish at base.

1286. Ostracion sebæ Bleeker. *Moamoa samasama.* Hawaii; Samoa; New Guinea (Macleay); East Indies.

Ostracion sebæ Bleeker, Verh. Bat. Gen., XXIV, 32, taf. 6, fig. 13, **East Indies.**
Ostracion bombifrons Hollard, Ann. Sci. Nat., 1857, VII, 168.
Ostracion camurum Jenkins, Bull. U. S. Fish Comm., XIX, 1899 (1901), 396, fig. 9, **Honolulu.**

Four specimens of this handsome species were taken on the reef at Apia. The color, well shown in Bleeker's figure, is characteristic, especially the undulating yellow stripe, most distinct on the tail.

The species is not rare on rocky shores about Hawaii, whence it was described as *Ostracion camurum.* The yellow undulating stripe is sometimes faint in Hawaiian examples, but these often agree fully with the Samoan.

1287. Ostracion oahuensis Jordan & Evermann. Hawaii.

This species is known from two examples from Honolulu. It is near *Ostracion sebæ*, but the spots are smaller, with none on the sides of the body.

LACTORIA Jordan & Fowler.

Lactoria Jordan & Fowler, Proc. U. S. Nat. Mus., XXV, 278, 1903 (*cornutus*).

1288. Lactoria galeodon Jenkins. Hawaii.

Ostracion diaphanus Steindachner, Denks. Ak. Wiss. Wien, LXX, 517, 1900, **Laysan, Hawaii**; not of Lacépède.

This species is rather rare about Hawaii, all the examples seen being small. It is nearly related to *Lactoria diaphana* of Japan.

1289. Lactoria schlemmeri Jordan & Snyder. Laysan.

Lactoria schlemmeri Jordan & Snyder, Proc. U. S. Nat. Mus., XXVII, 945, 1904, **Laysan.**

1290. Lactoria cornuta (Linnæus). *Moamoa.* Samoa; Fiji; Guam; Marcus I.; New Guinea; Tahiti and Shortland I. (Seale); East Indies; Japan.

Of this fantastic species, the most abundant of the group in the East Indies, we have two specimens from Apia. Dr. Günther records it from Fiji, Seale from Guam, and Bryan & Herre from Marcus Island. In the length of the horns this species is subject to considerable variation.

ARACANA Gray.

1291. Aracana spilonota Gilbert. Hawaii.

Family TETRAODONTIDÆ.

Species of this group are more abundant in the East Indies than in the South Seas. About Samoa they are not very common. They are known as *sui* and are regarded as poisonous, although none of the species has the bad repute possessed at Hawaii by *Tetraodon hispidus.*

SPHEROIDES (Lacépède) Duméril.

1292. Spheroides oceanicus (Jordan & Evermann). Hawaii.

Lagocephalus oceanicus Jordan & Evermann, Bull. U. S. Fish Comm., XXII, 199, 1902 (1903). **Honolulu.**

This species is known from two young examples taken at Honolulu. It is a typical *Lagocephalus,* close to the European *Spheroides pennanti.* There is a most perfect gradation between the type of *Lagocephalus* and that of *Spheroides.*

1293. Spheroides sceleratus (Forster). Tahiti; New Guinea (Macleay); East Indies.

1294. Spheroides hypselogeneion (Bleeker). Fiji; Samoa; East Indies; Australia.

Tetraodon hypselogeneion Bleeker, Nat. Tijds. Ned. Ind., III, 300, **East Indies.** Bleeker Atlas, V, 61, tab. CCXIII, fig. 5, East Indies. Günther, Cat., VIII, 277, 1870, Zanzibar, Seychelles Fiji, Australia

Of this species we found four examples, two at Apia and two at Pago Pago. The coloration is well represented in Bleeker's plate. The specimens from Apia have the dark bars on the head and the dark lateral stripe strongly marked.

Life colors of a specimen from Apia, dark olive, much speckled with whitish, a dark lateral stripe with a creamy area below it; belly yellowish; iris golden yellow; four dark bars on side of head between gill opening and snout, most distinct below eye; fins unicolored.

1295. Spheroides oblongus (Bloch). Faté (Seale); East Indies.

1296. Spheroides florealis Cope. Hawaii.

This species is known to us from a few young examples from Hawaii.

1297. Spheroides insularum De Vis. New Hebrides.

Spheroides insularum De Vis, Proc. Linn. Soc. N. S. W., VIII, 456, 1884, **Api (New Hebrides).**

1298. Spheroides lævis (De Vis). South Seas.

Tetraodon lævis De Vis, Proc. Linn. Soc. N. S. W., VIII, 456, 1884, **South Seas.**

TETRAODON Linnæus.

This genus contains short-bodied species, with the nasal tentacle bifid, without opening. The species are especially abundant in the East Indies.

1299. Tetraodon aerostaticus (Jenyns). Tahiti; Guam; New Guinea (Macleay); Faté (Seale); Japan; East Indies.

Tetraodon lineatus Bloch, Ausland. Fische, I, 1785, 128, pl. CXLI, and of various authors (not of Linnæus). Schlegel, Fauna Japonica, Poiss., 287, pl. CXXV, fig. 2, 1847, Nagasaki.

Crayracion lineatus Bleeker, Atlas, v, 70, tab. ccvi, fig. 1, tab. ccxii, fig. 1, Bali, Singapore, Celebes, Amboina.
Tetraodon aërostaticus Jenyns, Voyage Beagle, 152, 1842, locality unknown.
Tetraodon lineatus, Kner, Novara Fische, 409, Tahiti.

This species, common from Japan to the East Indies, is recorded by Günther from Fiji, by Kner from Tahiti, and by Seale from Guam. The black stripes on the abdomen on this and other species disappear with age.

It is very close to *Tetraodon stellatus* Bloch & Schneider, of the East Indies, with which Dr. Günther identifies it. The latter has, however, the dorsal spotted, like the caudal, besides other minor differences. In *Tetraodon aerostaticus* the dorsal is immaculate. The back in both is profusely spotted with black.

1300. Tetraodon mappa Lesson. New Guinea (Macleay); East Indies.

1301. Tetraodon hispidus Linnæus. *Sue.* Hawaii; New Guinea; Samoa; Aneiteum; New Hanover (Peters); China; East Indies; Panama.

? *Tetraodon hispidus* Linnæus, Syst. Nat., ed. x, 1758, 333, China; after Lagerstrom (probably this species, the spots not indicated in Lagerstrom's figure); Syst. Nat., ed. xii, 1766, 411.
Tetraodon hispidus, Günther, Cat., viii, 297, 1870, Red Sea, Zanzibar, Ceylon, Mozambique, Port Natal.
Tetraodon perspicillaris Rüppell, Atlas Fische, 63, Red Sea.
Tetraodon implutus Jenyns, Voy. Beagle, Fish, 152, 1842, Vanicolo.
Crayracion implutus (as *laterna* in plate), Bleeker, Atlas, v, 71, tab. ccv, fig. 3, Sumatra, Cocos, Solor, Timor, Batjan, Amboina, Banda.
Tetraodon laterna Richardson, Voy. Sulphur, 1842, 124, pl. lxi, fig. 2, Canton; after an incorrect drawing by John Reeves. Richardson, Ichth. China, 199, 1846, Canton.
Arothron laterna, Bleeker, Enum. Pisc. Archip. Ind., 200.
Tetraodon hispidus (*semistriatus*), Günther, Cat., viii, 1870, 297, Amboina, Aneiteum, Australia.
Arothron erethizon Jordan & Gilbert, Proc. U. S. Nat. Mus., v, 1882, 631, Panama.

This species is very abundant in the lagoons and mullet ponds about Honolulu. It is regarded as excessively poisonous, *muki-muki*, or deadly death, being its local name. A single specimen nearly a foot long was taken at Apia. It is common in the East Indies, and we can see no difference between Hawaiian specimens and others from the Riukiu Islands. It is not certain, however, that this species is the original *Tetraodon hispidus* of Linnæus.

The Samoan specimen is nearly smooth, dark olive, with round brown spots on sides of head as well as on sides and back of body; base of caudal fin with many round spots, smaller than those on body; dark stripes on belly persistent; gill-opening black with white rings; eye with white rings; vent pale; tip of caudal dusky and unspotted.

1302. Tetraodon reticularis Bloch & Schneider. New Guinea; New Britain; Guam; East Indies.

Tetraodon reticularis Bloch & Schneider, Syst. Ichth., 1801, 506, Malabar. Gunther, Cat. viii, 296, Amboina, Celebes, Pinang. Peters, Berl. Mon., 1876, 853, New Britain. Seale, Bishop Museum 1901, 119, Guam.
Arothron testudinarius Müller, Arch. Nat., ix, 330.
Crayracion testudineus Bleeker, Atlas, v, 71, tab. ccxii, fig. 3, East Indies; not *Tetraodon testudineus* of Linnæus.

1303. Tetraodon nigropunctatus Bloch & Schneider. *Sue.* New Guinea; Fiji; Samoa; East Indies. (Pl. xxxv.)

Tetraodon nigropunctatus Bloch & Schneider, Syst. Ichth., 1801, 507, Tranquebar. Günther, Cat., viii, 293, Zanzibar, Amboina, Flores, Sumatra, Halmahera.
Crayracion nigropunctatus, Bleeker, Atlas, v, 71, tab. ccvi, fig. 4, East Indies.
Tetraodon diadematus Rüppell, Atlas Fische, 65, pl. xvii, fig. 3, Red Sea.
Tetraodon trichoderma Bleeker, Nat. Tijds. Ned. Ind., v, 532, Sumatra; examples with long bristles.
Tetraodon trichodermatoides Bleeker, Nat. Tijds. Ned. Ind., vi, 336, Flores.
Arothron melanorhynchus Bleeker, Nat. Tijds. Ned. Ind., ix, 111.
Tetraodon nigropunctatus var. *citrinella* Gunther, Cat., viii, 293, 1870, Fiji; bright yellow examples.

This species is very common about Apia and Pago Pago. It is known as *sui*, and is regarded as poisonous. Most of our specimens are very typical, brown with black vent and snout, the caudal edged with pale, and the spinules short. Some similarly colored have the body covered with bristles so long as to give the appearance of coarse fur. Others are intermediate in this regard, and one has the ground-color bright lemon-yellow. It seems clear that all belong to the same species that Günther has indicated.

We have 20 specimens from Apia and Pago Pago. Life colors of one from Apia, blackish olive, unmarked, the spines white; gill-opening black; all the fins dull olive, the posterior part fading to yellow, brightest on pectoral. Some have sparse black spots on belly. Others are dark olive above, bright yellow below, with or without black spots. Margin of caudal always yellowish, vent always black.

One specimen from Pago Pago, the variety *citrinellus*, was lemon-yellow, the back irregularly blackish olive.

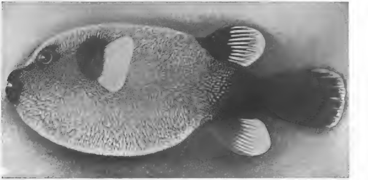


FIG. 70.—*Tetraodon nigropunctatus* Bloch & Schneider.

1304. Tetraodon immaculatus Bloch & Schneider. Fiji (Günther); Samoa; New Ireland; Micronesia; New Caledonia; Faté; Shortland I. (Seale); New Guinea; East Indies.

ADULT EXAMPLES.

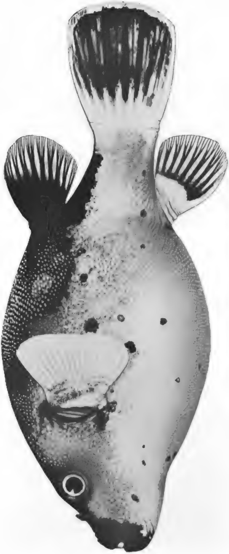
Tetraodon immaculatus Bloch & Schneider, Syst. Ichth. 1801, 507; after *Tetraodon sans tache* of Lacépède, I, 475. Gunther, Cat., VIII, 291, Natal, Zanzibar, Mauritius, Pinang, New Caledonia, Australia.
Crayracion immaculatus, Bleeker, Atlas, V, 75, tab. CCXI, fig. 1, East Indies.
Tetraodon sordidus Ruppell, Atlas Fische, 64, 1828, **Red Sea.**
Tetraodon parrus De Joannes, Mag. Zool. 1835, IV, pl. 15.
Tetraodon scaber Eydoux & Souleyet, Voy. Bonite, 214, pl. 10, fig. 1.
Tetraodon basilevskianus Basilewsky, Mem. Soc. Mosc., X, 1855, 202.
Tetraodon kunhardti Bleeker, Nat. Tijds. Ned. Ind., 197.
Tetraodon aspilus Bleeker, Nat. Tijds. Ned. Ind., II, 495, **East Indies.**

YOUNG EXAMPLES.

Tetraodon manillensis Procé, Bull. Philom. 1822, 130, **Manila.** Peters, Berl. Mon. 1876, 853, Amboina, New Ireland.
Crayracion manillensis Bleeker, Atlas, V, 69, tab. CCVIII, fig. 2, East Indies.
Tetraodon virgatus Richardson, Voy. Erebus and Terror, 62, pl. 39, figs. 8 and 9, 1846.
Tetraodon immaculatus var. *virgatus*, Gunther, Cat., VIII, 292, Ceram, Amboina, Philippines, Cape York, Sydney, Micronesia.
Tetraodon carduus Cantor, Malay, Fish, 375, 1850, **Pinang.**
Holacanthus pilosus Gronow, Syst., ed. Gray, 28, 1854.
Dilobomycter longicaudus Bibron, Rev. Zool. 1855, 279.
Tetraodon immaculatus, Fowler, Proc. Ac. Nat. Sci. Phila. 1900, Samoa.

Of this species we have five young from Apia, agreeing very closely with Dr. Bleeker's figure of *Crayracion manillensis*. The color is greenish with about 8 dark streaks on each side, the caudal dark with darker edge, the gill-opening black.

Apparently Dr. Günther is right in regarding *Tetraodon manillensis*, with the back streaked, as the young of *Tetraodon immaculatus*, in which species the back is plain olive. Specimens before us from Negros, in the Philippines, show that the black stripes on the back disappear with age. Both Günther and Bleeker record specimens of the striped form, *manillensis*, of 10 to 12 inches in length. All our



TETRAODON NIGROPUNCTATUS BLOCH & SCHNEIDER.

Samoan specimens are young, and all have the black stripes, but we have no doubt that they are specifically identical with the unstriped *Tetraodon immaculatus*. The best distinctive character of this species is the black edge to the caudal.

Color in life of a specimen from Apia, olive, white below, striped all over back and sides of belly with dark olive; fins pale gray, the caudal edged all around with black.

1305. Tetraodon lacrymatus Cuvier. Hawaii; Raiatea (Seale).

Tetraodon lacrymatus Cuvier, in Quoy & Gaimard, Voy. Uranie, Fishes, 201, 1824, **Maui.**
Oroides latifrons Jenkins, Bull. U. S. Fish Comm., XIX, 1899, (1901), 398, fig. 10, **Honolulu.**
Tetraodon meleagris, Smith & Swain, Proc. U. S. Nat. Mus., V, 1882, 141, Johnston I.; not of **Lacépède.**

This species, which is probably different from *Tetraodon meleagris* of the East Indies, is known from the Hawaiian Islands. The specimens from Johnston Island, called *Tetraodon meleagris*, probably belong here, as well as the type of *Tetraodon latifrons*. *Tetraodon meleagris* is found in the seas of tropical Japan and China. The single specimen examined by us from the Riu Kiu Islands is apparently different from those called *Tetraodon latifrons*. The species called *latifrons* must be the same as the *lacrymatus*, described long before, from the same waters.

1306. Tetraodon ophryas Cope. Samoa; Tahiti; Mangareva (Seale).

Tetraodon ophryas Cope, Trans. Am. Phil. Soc. 1870, 479, **Samoa.**
?*Tetraodon setosus* Rosa Smith, Bull. Cal. Ac. Sci., II, 6, 1886, **west coast of Mexico.**
Oroides ophryas, Fowler, Proc. Ac. Nat. Sci. Phila. 1900, 528, pl. XX, fig. 2; after Cope's type.

This species is known only from the original type from Samoa. It may be identical with *Tetraodon setosus* of the Mexican coast. *Tetraodon meleagris* Lacépède, from Asia, figured by Jordan & Fowler (Proc. U. S. Nat. Mus., XXIV, 253, fig. 8), also is allied to it.

1307. Tetraodon giganteus Castelnau. New Caledonia.

Tetraodon giganteus Castelnau, Proc. Zool. Soc. Victoria, 1873, 121, **New Caledonia.**

CANTHIGASTER Swainson.

(*Psilonotus* Swainson; *Tropidichthys* Bleeker; *Anosmius* Peters; *Eumycterias* Jenkins.)

This genus consists of small globe-fishes with the back angulated and the nostrils obsolete or little developed. The earliest name, *Canthigaster*, is defined without mention of any species, but the context admits of no doubt as to the species intended. The slightly better development of the nostrils in *Eumycterias* Jenkins is a character of very light weight, and the genus *Eumycterias* can not be maintained.

1308. Canthigaster solandri (Richardson). *Sue mimi.* Tahiti; Samoa; Guam; Raiatea (Seale).

Tetraodon solandri Richardson, Voy. Sulphur, Fish, 125, pl. 57, fig. 4-6, 1845, **Tahiti.** Richardson, Voy. Samarang, 19, 1848, Tahiti.
Tropidichthys papua, Seale, Bishop Museum 1901, 118, Guam; probably not of Bleeker.
?*Tetraodon papua* Bleeker, Journ. Ind. Arch., II, 638, **New Guinea.**

This little species from Tahiti was originally described as having the body covered with greenish yellow spots, each with a dark border with blue cross streaks between the eyes, with some of the stripes on the back extended as streaks; caudal with blue spots, forming interrupted blue streaks. As one of our Samoan species agrees perfectly with this description, we identify it as *Canthigaster solandri*. The fish called *solandri* by Steindachner from Laysan seems to be *Canthigaster jactator*. The specimens from Guam, called *Tropidichthys papua*, evidently belong here. *Canthigaster papua* Bleeker, from New Guinea, is evidently closely related, but it has the blue streaks on the back more or less confluent into lines.

In our eight typical examples of *Canthigaster solandri*, from Apia, the spots are small on the cheek and snout and distinctly blue in color. In eight examples from Pago Pago, the spots on the body are duller, and those on the chin, throat, and cheek, as far back as the gill-opening, are dark bronze-blue, eye with radiating streaks, caudal distinctly barred. This may be a distinct species, but it seems to intergrade perfectly with the typical form, one specimen of the latter having larger bronze-blue spots at the throat. We have about 25 specimens from Apia and Pago Pago.

Life colors of two specimens from Apia, dark brown, orange on side, yellow below, with a median blue, orange-edged streak before vent; sides with round sky-blue spots, most distinct on head; caudal orange, barred with blue spots; dorsal, anal, and pectoral clear translucent; a black spot at base of dorsal.

A series of six specimens, mostly from Pago Pago, were very aberrant. Life colors of one of these, rich orange-brown, paler bright orange on snout, light orange on belly; everywhere round pale blue spots edged with darker blue, these largest on side of belly, smaller on side of tail, deepest on middle of back; a faint blue median ventral streak; blue cross-streaks on snout and as far back as behind eye, 7 in all, the posterior darker edged; spots confluent into a streak on front of back; a black spot below dorsal, with 4 blue spots and streaks about it, a curved blue streak above it on fin; back of tail with spots only; tail orange, with blue spots in vertical rows, and a dark blue edge; fins otherwise colorless orange, with blue spots about vent.

In alcohol these specimens have the spots larger and sparser, and the spots below the eye and on the ventral pouch are very much enlarged, separated by a narrow network of the ground-color; chin and throat with an irregular patch of olive; streaks across eye very distinct; spots on sides of snout generally brown, the color very different from that of the spots on the body.

Life colors of a young individual from Apia, dark olive with blue spots; blue stripes on head and a black blue-edged ocellus at base of dorsal; caudal with pale blackish cross-streaks.

1309. Canthigaster papua (Bleeker). New Guinea; East Indies.

1310. Canthigaster jactator (Jenkins). Hawaii; Laysan.

This species, profusely covered with large pale spots, was found on the reef about Honolulu. The specimens called by Steindachner *Tetraodon solandri*, from Laysan, seem to be the same. A very near relative is *Canthigaster punctatissimus* from the Panama region and the Galapagos.

1311. Canthigaster bitæniatus (Jenkins). Hawaii.

? *Tetraodon caudofasciatus* Günther, Cat., VIII, 304, 1870, no locality with plate.
Tetraodon caudofasciatus, Steindachner, Denks. Ak. Wiss. Wien 1900, 518, Laysan.
Eumycterias bitæniatus Jenkins, Bull. U. S. Fish Comm., XIX, 1899 (1901), 400, fig. 12, Honolulu.

This species is found about Honolulu. In coloration it is almost exactly identical with the common Japanese species, *Canthigaster rivulatus* Schlegel. In view of the remote habitat, the Hawaiian species may be kept provisionally distinct.

Apparently the species called *Tetraodon caudofasciatus* by Steindachner is the same as *Canthigaster bitæniatus*. The original *Tetraodon caudofasciatus* of Günther is from an unknown locality. It may be the same also, as the difference in description is slight. The back is said to be spotted with brown in *Canthigaster caudofasciatus*, and the caudal is crossed with dark bands. These traits are not found in *Canthigaster bitæniatus* nor in *Canthigaster rivulatus*.

1312. Canthigaster caudofasciatus (Günther). Laysan (Steindachner, as *T. callisternis* Ogilby).

1313. Canthigaster janthinus (Vaillant & Sauvage). Hawaii.

Tetraodon janthinus Vaillant & Sauvage, Ann. Mus. 1875, 286, Honolulu.

This species, an ally of *Canthigaster psegma*, has not been recognized since it was originally taken by Ballieu at Honolulu. We should regard *janthinus* and *psegma* as identical, were it not that Sauvage describes the lateral spots as large, and the dorsal fin is stated to be black. Only the caudal is black in *Canthigaster psegma*.

1314. Canthigaster psegma (Jordan & Evermann). Hawaii; Samoa.

This species has been found about Honolulu and about Samoa. The Samoan examples, four in number, differ a little from the original types, especially in having less clearly defined streaks about the eyes.

We have two large specimens from Apia. The species is very close to *Canthigaster oahuensis* as figured by Dr. Jenkins. The markings of the head and fins are almost identical, and the oblong black spots on the sides are the same. But our specimens show no trace whatever of stellate blue spots, and these are very conspicuous in *Canthigaster oahuensis*.

Life colors of a specimen from Apia, dark olive with orange-brown shades and faint blue spots; blue and bronze streaks with a few blue specks radiating from eye; cheeks brownish gray with thick-set dark-blue spots above and bronze spots behind them; dorsal and anal pale olive, a black bar across base of each; no black blotch on back; caudal dusky, blackish; pectoral dusky; cheek closely covered with close-set dark spots, which form narrow oblique brown streaks in front; sides of belly with oblong black spots, all smaller than pupil.

Another specimen from Apia was brownish black; cheek grayish with blue-black spots, forming streaks below; side with a few blackish streaks and blue spots; middle line of belly darker; dorsal and anal dusky at base; caudal all black, the fins otherwise colorless.

1315. Canthigaster epilamprus (Jenkins). Hawaii.

1316. Canthigaster oahuensis (Jenkins). Hawaii.

This species is found in the reefs about Honolulu, where it is apparently rare. It is one of the deep-bodied species, like *Canthigaster psegma*.

1317. Canthigaster cinctus (Solander). Tahiti; Samoa; New Guinea (Macleay); Hawaii; East Indies.

Tetraodon gronovii Cuvier, Regne Anim., ed. II, 1827, no description.
Tetraodon cinctus Solander, Richardson Voy. Samarang, 19, 20, 1850, **Tahiti; on a drawing** by Solander.
Tropidichthys valentini Bleeker, Nat. Tijds. Ned. Ind., IV, 130, 1853, **Amboina.**
Tropidichthys valentini Bleeker, 3de Bijdr. Amboina, 130, Amboina.
Psilonotus valentini Bleeker, Atlas, Gymnodontidæ, v, 80, tab. CCVIII, fig. 4.
Tetraodon valentini Günther, Cat., VIII, 305.
Holacanthus balistæformis Gronow, Cat. Fish, ed. Gray, 1854, 25.
Tetraodon coronatus Vaillant & Sauvage, Ann. Mus. 1875, 285, **Hawaii.**

This species, distinguished at once by two blackish cross-bars, was seen by us at Hawaii only. The species called *coronatus* is certainly the *cinctus* of Solander.

Tetraodon cinctus is described as studded above with small round dots, which are also found on the caudal fin. Besides these there are two oblique black bars which embrace the fore part of the belly, the interval between them light yellow; traces of other dark bars appear behind.

It is evidently identical with *Canthigaster coronatus*. Dr. Gilbert's single specimen of the latter from Hawaii agrees perfectly with Günther's description of *Canthigaster valentini*. Bleeker's figure, however, differs in showing blue streaks on the head, the posterior far less developed, and the caudal fin unspotted, the black stripes on its lower and upper margins less plain than in *coronatus*.

Bleeker's description fits well the specimen obtained in Hawaii by Dr. Gilbert, and there seems no reason for doubting the identity of *C. cinctus* and *C. coronatus* with the East Indian form, *Canthigaster valentini*. The name *cinctus* has priority.

1318. Canthigaster compressus (Procé). Faté (Seale); East Indies.

(*Tetraodon striolatus* Quoy & Gaimard.)

1319. Canthigaster bennetti (Bleeker). New Guinea (Macleay); East Indies.

Family DIODONTIDÆ.

DIODON Linnæus.

1320. Diodon hystrix Linnæus. *Tauta.* Samoa; Hawaii; Tahiti; Guam; Johnston I.; New Guinea; all warm seas.

Occasionally taken in Samoa. We have 2 specimens.

1321. Diodon holacanthus Linnæus. Laysan (Steindachner, Denks. Ak. Wiss. Wien 1900, 518, as *Diodon sexmaculatus*); warm seas.

This species may be the young of the preceding.

1322. Diodon nudifrons Jenkins. Hawaii.

CHILOMYCTERUS Bibron

1323. Chilomycterus affinis Günther. Hawaii; Lower California; Galapagos Is.; Japan.

Family MOLIDÆ.

RANZANIA Nardo.

1324. Ranzania makua Jenkins. Hawaii; Japan.

Family SCORPÆNIDÆ.[a]

MERINTHE Jordan & Evermann.

1325. **Merinthe macrocephala** (Sauvage). Hawaii.

1326. **Merinthe bandanensis** (Bleeker). Faté (Seale); East Indies.

Scorpæna bandanensis Bleeker, Banda, I, 237, 1851, **Banda.**
Scorpæna haplodactylus Bleeker, Ceram, II, 698, 1852, **Ceram.**
Scorpæna haplodactyla, Günther, Cat., II, 117, Banda, Ceram, Fiji(?).

IRACUNDUS Jordan & Evermann.

1327. **Iracundus signifer** Jordan & Evermann. Hawaii.

SEBASTOPSIS Gill.

1328. **Sebastopsis parvipinnis** (Garrett). Hawaii (Garrett); Raiatea.

Scorpæna parvipinnis Garrett, Proc. Cal. Ac. Sci. 1863, 105, **Sandwich Is., Raiatea.** Günther, Fische der Südsee, 76, taf. 51, fig. D, Raiatea.

This species is known to us only from the accounts of Günther and Garrett. It seems well distinguished by its low dorsal spines.

1329. **Sebastopsis kelloggi** Jenkins. Hawaii.

This little fish is abundant about the Hawaiian islands. It is close to *Sebastopsis guamensis* (*polylepis*), but it differs from all the Polynesian species examined by us in having, besides an auxiliary spine, four spines on the edge of the preopercle. There are three of these spines in *Sebastopsis guamensis* and *Sebastopsis scabra*.

1330. **Sebastopsis guamensis** (Quoy & Gaimard). *La'otale.* Samoa; Tahiti; Guam; Caroline Is.; Tonga; Palau; Fiji; East Indies.

?*Scorpæna rawakensis* Quoy & Gaimard, Voy. Uranie Zool., 325, 1824, **Rawak.**
Scorpæna guamensis Quoy & Gaimard, Voy. Uranie Zool., 326, 1824, **Guam.**
Sebastopsis guamensis, Streets, Bull. U. S. Nat. Mus., VII, 96, Samoa. Fowler, Proc. Acad. Nat. Sci. Phila. 1900, 521, Tahiti.
Scorpæna guamensis, Klunzinger, Fische Rothen Meeres, Tahiti. Günther, Fische der Südsee, 74, Caroline Is., Red Sea, Samoa, Tonga, Palau.
Scorpæna rubropunctata Ehrenberg in Cuvier & Valenciennes, Hist. Nat. Poiss., IV, 324, 1829, **Red Sea.**
Scorpæna chilioprista Rüppell, Neue Wirbelthiere, 107, taf. 27, fig. 3, 1835, **Red Sea.** Günther, Cat., II, 121.
Sebastes polylepis Bleeker, Nat. Tijds. Ned. Ind., 1851, II, 173, Amboina. Gunther, Cat., II, 106, Amboina, East Indies.
Sebastopsis erinacea Garman, Bull. Mus Comp. Zool., XXXIX, 8, 231, pl. I, fig. 2, **Viti Levu (Fiji).**
Sebastes minutus Cuvier & Valenciennes, Hist. Nat. Poiss., IV, 348, 1829, **Moluccas, Ladrones, Society Is.** Günther, Cat., II, 106.

Of this species we have about 50 specimens from Samoa. It is well separated from *Sebastopsis scabra* by the shorter anal spine. It is impossible for us to tell certainly what species was intended in the descriptions of *Scorpæna guamensis* and *minutus*, but this species is certainly the *guamensis* of Günther and Klunzinger, as also the *polylepis* of Bleeker and the *erinacea* of Garman. We can not identify *Scorpæna rawakensis.*

Life colors of a specimen from Apia, light olive with many brown spots and three dark brown cross-shades; a white bar across base of caudal; fins all reddish brown, bright brick red at tip, barred with pale bluish gray; throat and belly dark.

Another specimen was dusky brown, four dusky cross-bars, sides with greenish reticulations around dusky spots; fins all closely reticulated reddish brown and bluish gray; throat paler.

1331. **Sebastopsis scabra** (Ramsay & Ogilby). Samoa; north Australia.

Sebastes scaber Ramsay & Ogilby, Proc. Linn Soc. N. S. W., X, 1885, **Shark reef (Australia).**

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[a] *Scorpæna vaigiensis* from Waigiu (Quoy & Gaimard, Voy. Uranie, 324) we can not place. It has dorsal XIV, 11, anal III, 5.

This species is distinguished from *Sebastopsis guamensis* by the very much longer second anal spine. It is equally abundant at Samoa, and has doubtless been confused by authors with *Sebastopsis guamensis* under that and other names. We have about 40 examples from crevices in the reefs of Apia and Pago Pago. *Scabra* has an orbital tentacle.

Life colors of a specimen from Pago Pago, brown, the fins barred with brownish red; a large jet black spot on opercle; ventrals and belly yellowish.

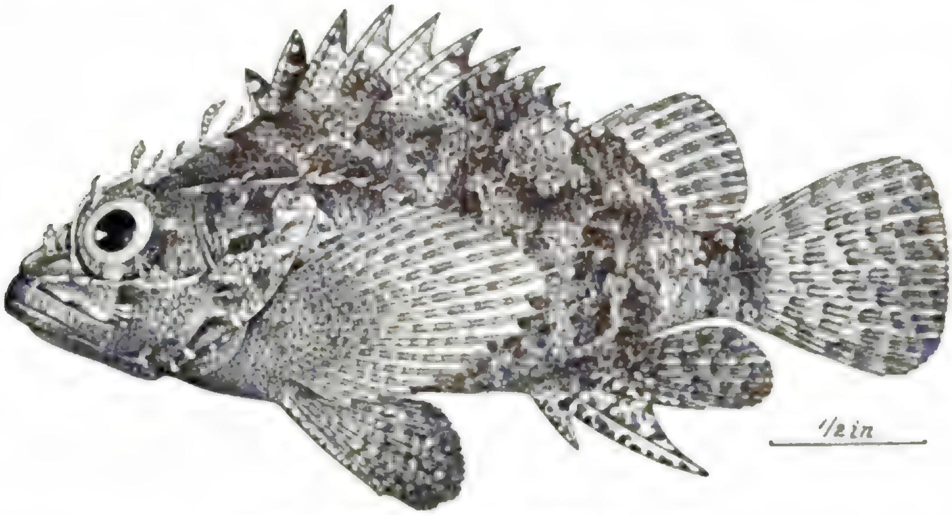


FIG. 71.—*Sebastopsis scabra* (Ramsay & Ogilby).

1332. Sebastopsis novæ-guineæ (Sauvage). New Guinea (Nouv. Arch. Mus. 1878, 129).

SCORPÆNOPSIS Bleeker.

1333. Scorpænopsis cirrhosa (Thunberg). Tahiti (Günther); New Guinea (Macleay); Japan; East Indies.

1334. Scorpænopsis gibbosa (Bloch & Schneider). *Nofu.* Tahiti; Palau; Hawaii; Samoa; New Guinea; East Indies.

(*Scorpænopsis catocala* Jordan & Evermann, Hawaii.)

This species is rather common about Samoa, where we obtained three good-sized specimens, and still more common about Hawaii. It is certain that the *diabolus* of Cuvier & Valenciennes is the same as the *gibbosa* of Bloch & Schneider. The characters used by Bleeker to distinguish these species can not be trusted. *S. gibbosa* is best known by its wide, depressed interorbital area, much wider than the eye, and by the deep nuchal pit; there is a black band at the shoulders covering part of the spinous dorsal fin and a black notch at tip of upper jaw. *Scorpænopsis catocala* from Hawaii and *Scorpæna nesogallica* from Ile de France can not be separated from *S. gibbosa*.

There is a broad black band on the inner side of the pectoral fin near the margin, and this, in the adult, breaks up into spots.

Life colors of a specimen from Apia, violet-black, the dark shades light olive-gray, the throat very dark; lining membranes of jaws bright yellow; axillary region light gray, mottled with olive; belly creamy yellowish; pectoral banded with black, orange and yellow within, grayish at tip; ventrals black, pale-edged; caudal with a broad black band, pale gray at base and tip; spinous dorsal with a purple blotch continued as a band on body.

Another specimen, from the same locality, was dark reddish brown, light bright reddish brown below; fins with the pale parts all reddish brown of varying shades; axil dark with pale spots.

1335. Scorpænopsis cacopsis Jenkins. Hawaii; Tahiti.

1336. Scorpænopsis novæ-guineæ Cuvier & Valenciennes. Samoa; New Guinea.

?*Scorpæna novæ-guineæ* Cuvier & Valenciennes, Hist. Nat. Poiss., IV, 320, 1829. **New Guinea.**
Scorpæna papuensis Cuvier & Valenciennes, Hist. Nat. Poiss., IV, 321, 1829. **New Guinea.**
Scorpæna gibbosa, Günther, Cat., II, 119. Sauvage, Poiss. Madagascar, 279; not of Schneider.

This species, distinguished from the true *Scorpænopsis gibbosa* by the narrow interorbital and smoother body, is known to us from a single example from Samoa. Among its best distinctive characters is that of the very long second anal spine, a feature not shown in the plate of Quoy & Gaimard, who may have had some other species in mind.

Life colors of a specimen from Apia, blackish, the belly creamy yellowish, with no red and no orange except in the inner angle of ventrals; all pale markings creamy white or creamy brown, a little orange-shaded in dorsal and anal and inner edge of ventral; inner side of pectoral olive with orange shades next to the black cross-band; axil olive with round brown spots.

1337. **Scorpænopsis altirostris** Gilbert. Hawaii.

1338. **Scorpænopsis zanzibarensis** (Playfair). New Guinea (Günther); Zanzibar.

SCORPÆNA (Artedi) Linnæus.

1339. **Scorpæna cooki** Günther. Raoul I.; Cook Is.; Raiatea (Seale).

Scorpæna cooki Günther, Fische der Südsee, 78, taf. 55, **Raoul I.**

SEBASTAPISTES Gill.

1340. **Sebastapistes dentatus** (Günther). Palau Is.

Scorpaena dentata Günther, Fische der Südsee, 76, 1873, **Palau Is.**

1341. **Sebastapistes coniorta** Jenkins. Hawaii.

1342. **Sebastapistes galactacme** Jenkins. Hawaii.

1343. **Sebastapistes corallicola** Jenkins. Hawaii.

?*Scorpæna asperella* Bennett, Zool. Jour., IV, 1829, 40, **Sandwich Is.** Günther, Fische der Südsee, 80, **Hawaiian Is.**
Sebastapistes corallicola Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (1903), 493, **Honolulu.**

It is impossible to identify Bennett's *S. asperella* with certainty. It is probably *Sebastapistes corallicola*, the red spot on the dorsal and the tentacle over the eye favoring this identification.

1344. **Sebastapistes ballieui** (Sauvage). Hawaii.

1345. **Sebastapistes coloratus** Gilbert. Hawaii.

1346. **Sebastapistes albobrunneus** Günther. Palau Is.

Scorpæna albo-brunnea Günther, Fische der Südsee, 77, 1873, **Palau Is.**

1347. **Sebastapistes strongius** (Cuvier & Valenciennes). Oualan, or Strong Island; Amboina.

We are unable to identify this species. Were it not for the plain-colored lower parts of the head, in the figure of Quoy & Gaimard, we should regard *Sebastapistes la'otale* as this species.

1348. **Sebastapistes laotale** Jordan & Seale, new species. *La'otale.* Samoa; Rarotonga.

Scorpæna tristis, Günther, Fische der Südsee, 77, **Rarotonga**; not of Klunzinger.

Head 2.45 in length; depth 2.75; eye 4 in head; dorsal XII,10; anal III, 6; about 22 modified scales in lateral line; snout 3.50 in head; interorbital 1.50 in eye, this space very concave with two small longitudinal ridges.

Body oblong, moderately compressed; depth of caudal peduncle equal to eye; mouth large; maxillary 1.75 in head; minute teeth in jaws and vomer, none on palatines; head spinate, preorbital ending in two sharp spines, one directed forward, the other downward and back, a strong spine at posterior end of the bony stay of cheek; three distinct spines below at the angle of preopercle; four distinct supraocular spines and four spines on each side of nuchal region; posterior nostril with a distinct spine, the anterior nostril with a short divided tentacle; opercle with three spines from its posterior part; origin of dorsal fin at posterior part of nuchal region, its longest spine 2.75 in head; base of anal fin 2.25 in length of head; second anal spine 2 in head; pectoral 1.20; ventral 1.80; caudal rounded 1.50 in head.

Life colors of a specimen from Pago Pago called *la'otale;* black and gray, with rosy tinge on caudal. Another from the same place has the red rosy salmon, the ground-color whitish, it and the rosy everywhere finely speckled with black points. A specimen from Apia was purplish black, mottled with gray with scarcely any shades of pink; the chin profusely barred.

Color in spirits, grayish mottled with brown, which takes somewhat the form of 6 irregular cross-bands, the first of which encircles the sides and upper part of head at eye, and the last one encircles the base of caudal fin; each side of lower jaw marked with about 6 alternating white and brown spots; a similar marking shown on upper jaw; dorsal fin with oblique brown bands, caudal with a wide brown band near the middle and tipped with white, and with about 5 dusky bands; ventral with 3 dusky bands; pectoral spotted with dusky black at the base, caudal with a wide brownish area near the middle.

This species is common in the tide-pools of the coral reefs of Samoa with *Sebastopsis scabra* and *Sebastopsis guamensis*, as described by Klunzinger. It differs from *Sebastapistes tristis* in the absence of orbital cirrus. Otherwise it agrees very closely with that species, but not one of our examples shows any trace of the orbital cirrus, which is well developed in *S. tristis*.

Many specimens from Apia. The type is no. 51761, U. S. National Museum, length 2 inches.

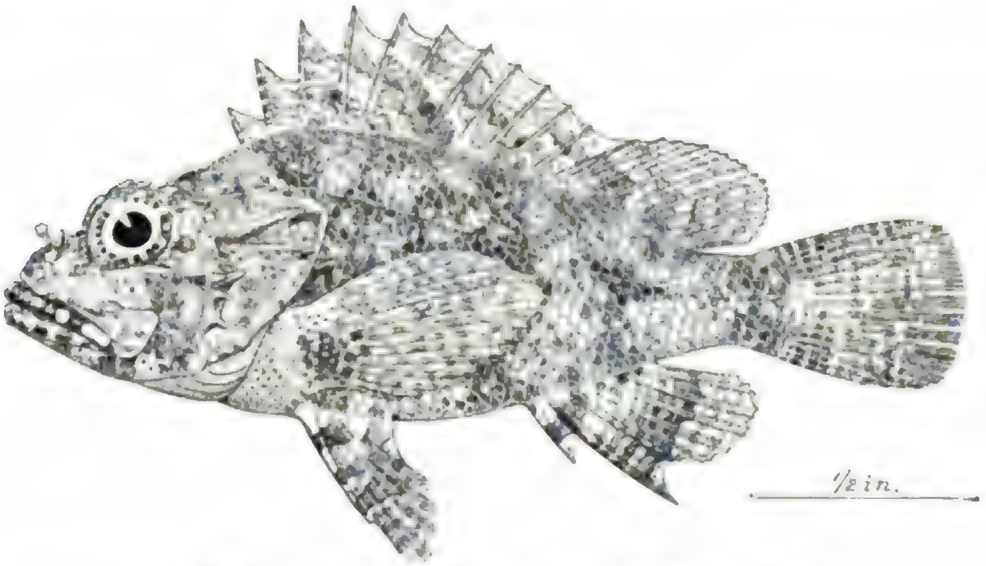


FIG. 72.—*Sebastapistes laotale* Jordan & Seale, new species. Type.

1349. Sebastapistes tristis (Klunzinger). Guam; Red Sea; Philippines.

Scorpæna tristis Klunzinger, Syn. Fische Rothen Meeres, 802, 1870, **Red Sea.**
Scorpæna bakeri Seale, Bishop Museum 1901, 126, **Honolulu;** op. cit., vol. I, no. 3, 120, Guam.

This species, distinguished by its orbital cirrus and by the blackish cross bands on the lower jaw, was not taken by us. Seale's description of *Scorpæna bakeri* agrees well with Klunzinger's account, and may be the same fish. Günther's *Scorpæna tristis* is said to have not "Hautläppchen." This may be our *Sebastapistes laotali*. We have examples of *S. tristis* from the Philippines, with the orbital cirrus well developed.

1350. Sebastapistes laniarius (Cuvier & Valenciennes). Guam.

1351. Sebastapistes nuchalis (Günther). Rarotonga.

Scorpæna nuchalis Günther, Fische der Sudsee, 76, 1873, **Rarotonga.**

SETARCHES Günther.

1352. Setarches remiger (Gilbert & Cramer). Deep seas of Hawaii.

1353. Setarches fidjiensis (Günther). Fiji.

Setarches fidjiensis Gunther, Challenger Fishes, 87, 19, Fiji.

PONTINUS Poey.

1354. Pontinus spilistius Gilbert. Deep seas of Hawaii.

HELICOLENUS Goode & Bean.

1355. **Helicolenus rufescens** Gilbert. Deep seas of Hawaii.

PLECTROGENIUM Gilbert.

1356. **Plectrogenium nanum** Gilbert. Deep seas of Hawaii.

CENTROPOGON Günther.

1357. **Centropogon australis** (White). Erromango; Palacky; Australia.

AMBLYAPISTUS Bleeker.

1358. **Amblyapistus tænianotus** (Cuvier & Valenciennes). Melanesia (Seale); East Indies.

1359. **Amblyapistus vestitus** (De Vis). South Seas.

Tetraroge vestitus De Vis, Proc. Linn. Soc. New South Wales 1884, 496, South Seas. (Dorsal XVI, 9.)

TÆNIANOTUS Lacépède.

1360. **Tænianotus triacanthus** (Lacépède). Tahiti; Raiatea (Günther); East Indies.

1361. **Tænianotus garretti** Günther. Hawaii.

1362. **Tænianotus citrinellus** Gilbert. Hawaii.

MINOUS Cuvier & Valenciennes.

1363. **Minous pictus** Günther. New Guinea.

(*Minous pictus* Günther, Challenger Fishes, 1880, 41.)

DENDROCHIRUS Swainson.

1364. **Dendrochirus zebra** (Cuvier & Valenciennes). Guam; Palau Island; Fiji; New Guinea; East Indies.

Pterois zebra Cuvier & Valenciennes, Hist. Nat. Poiss., IV, 367, Ile de France. Günther, Fische der Sudsee, 82, Indian Ocean, Pelew I. Seale, Bishop Museum 1901, 122, Guam. Garman, Bull. Mus. Comp. Zool., vol. XXXIX, 232, Fiji. Günther, Cat., II, 126, Amboina.

1365. **Dendrochirus brachypterus** (Cuvier & Valenciennes). Samoa (Günther); East Indies.

1366. **Dendrochirus sausaulele** Jordan & Seale, new species. *Sausaulele.* Samoa. (Pl. LII, fig. 1.)

Head 2.45 in length; depth 2.80; eye 3.55 in head, equal to snout; interorbital 2 in eye; dorsal XIII, 10; anal III, 6; pectoral 17; scales 8-44-13; maxillary 2.50 in head, reaching to below anterior third of eye.

Body elongate, compressed, profiles of trunk evenly curved; snout short, rounded; bands of minute teeth in jaws and vomer; a simple orbital tentacle one-half length of eye; a simple fleshy flap prolonged into a tentacle over anterior nostril; five simple tentacles on the anterior margin of snout; a wide flap from lower anterior margin of preorbital, and two similar flaps from lower limb of preopercle; a single small nasal spine on each side of snout; four orbital and seven nuchal spines on each side; bony stay of cheek without distinct spines; a small sharp spine on preopercle at posterior termination of the bony stay and two small spines below this on the angle; gillrakers short, 10 on lower limb; depth of caudal peduncle scarcely equal to eye; pectoral fin 2.10 in length, reaching to below posterior axil of dorsal, the membranes of lower rays only being slightly incised; ventral reaching to origin of anal; caudal and anal of about equal length, 2.50 in head.

Color in spirits, dull whitish with seven broad brown bands around the body, first over nuchal region, where the band is broken and the mid segment is in advance, second from origin of dorsal through axil of pectoral, third from 4th–5th dorsal spines, fourth from 8th–9th dorsal spines, fifth from 1st–3d dorsal rays, sixth from 7th–9th dorsal rays, the seventh band circling the caudal peduncle and sending a brown line back to base of caudal; a narrow indistinct line between the 2d and 3d bands and another between the 4th and 5th bands; a black line from base of orbital tentacle through eye to posterier end of bony stay; a dark blotch on cheek below anterior part of bony stay, another on side of snout, and another round spot on anterior part of interorbital; eye with five radiating black lines; fins all with black cross bands except the ventral, which is bluish; axil of pectoral black, with an upper and lower white spot, and some white dots on inner base of rays; a black spot on base of pectoral, and on lower part of opercle; under part of head and top of snout white.

Four specimens from Apia, where it lurks in the crevices of the reefs. The type is no. 51760 U. S. National Museum, 4.85 inches long, from Apia. We have also one specimen from Pago Pago, represented in the accompanying colored figure.

1367. **Dendrochirus chloreus** Jenkins. Hawaii.

1368. **Dendrochirus barberi** (Steindachner). Hawaii.

(*Dendrochirus hudsoni* Jordan & Evermann.)

PTEROIS Cuvier.

1369. **Pterois sphex** Jordan & Evermann. Hawaii.

1370. **Pterois volitans** (Linnæus). *Sausaulele.* Samoa; Tahiti; Palau [illegible]; New Guinea (Macleay); New Britain (Peters); East Indies. (Pl. LI.)

This large and violently stinging fish is not rare about Samoa, where half a dozen examples were taken. Life colors of one from Apia called *sausaulele*, blackish red, fading to pale olive-brown posteriorly, the front of head abruptly bright pale brownish red; body covered by narrow sharply defined white streaks, bounding black streaks of the ground color, one pair below eye, one pair across nape; 5 more streaks on body, the first three Y-shaped, divided above and one of them below also; breast and belly with alternating white and blackish cross-bars; cirrus black, light red at tip; dorsal light and dark red; soft dorsal, anal, and caudal with dark cross-bars; ventral deep red, streaked with white, the spine white; pectoral dusky red, with two white crescents at base and a white axillary spot, the rays bright pink-red; two horizontal dark-edged streaks on caudal peduncle; interorbital pale pink.

1371. **Pterois radiata** Solander. Tahiti; Paumotu Is.; Samoa; Kingsmill I.

One specimen, called *sausaulele*, was taken by us at Samoa. Life colors, black with whitish streaks, these brownish red on head; long dorsal rays reddish brown at tip.

1372. **Pterois vittata** Sauvage. Marquesas Is.

Pterois vittata Sauvage, Nouv. Arch. Museum, 1878, 135, Nukahiva.

PELOROPSIS Gilbert.

1373. **Peloropsis xenops** Gilbert. Deep seas of Hawaii.

INIMICUS Jordan & Starks.

1374. **Inimicus maculatus** (Cuvier & Valenciennes). Waigiu; New Britain; New Guinea.

Inimicus maculatus Cuvier & Valenciennes, Hist. Nat. Poiss., IV, 434, 1829, **Waigiu.** Lesson, Voy. Coquille, 210, plate 20. Günther, Cat., II, 150, Waigiu.
Pelor maculatum, Peters, Berl. Mon. 1876, 834, New Britain.

SYNANCEJA Bloch & Schneider. (*Synancidium* Müller; *Synanceichthys* Bleeker.)

According to Bleeker, the genus *Spurco*, or *Synanceichthys*, to which our species belongs, differing from *Synanceja* in the absence of palatine teeth, can not be maintained as a distinct genus, these teeth being frequently wanting in *Synanceja horrida*.

1375. **Synanceja verrucosa** Bloch & Schneider. *Nofu.* Samoa; Fiji; Tahiti; New Hanover; Strong I.; Borabora; Guam; New Guinea (Macleay); East Indies.

Synanceia thersites Seale, Bishop Museum, vol. I, no. 3, 1901, 121, **Guam.**

This most uncomely fish abounds in the tide pools of the coral reefs of Samoa. It is much dreaded by the natives on account of its poisonous dorsal spines.

A specimen from Apia called *nofu* in life was the color of coral sand, the surface mud-colored, with concealed orange patches showing on head and body; caudal with a blackish cross-band; a whitish cross-band at base and one at tip.

EMMYDRICHTHYS Jordan & Rutter.

1376. **Emmydrichthys vulcanus** Jordan & Rutter. Tahiti.

Emmydrichthys vulcanus Jordan & Rutter, Proc. Cal. Ac. Sci., 2d ser., vi, 1896, 562), **Society Is.** (by error stated to be from Hawaii).

This species is known only from the original type from Tahiti.

Family CARACANTHIDÆ.

CARACANTHUS Kröyer.

1377. **Caracanthus maculatus** Gray. *Tu'u'u.* Hawaii; Samoa; Tahiti.

This little fish is not rare in the coral reefs of Samoa, where several specimens were taken in company with *Pseudogobiodon citrinus.*

Life colors of a specimen from Apia called *tu'u'u,* dark uniform, coppery brown.

AMPHIPRIONICHTHYS Bleeker.

This genus is very close to *Caracanthus,* differing in the continuous dorsal fin. It was taken by us with the preceding on the reefs of Honolulu.

1378. **Amphiprionichthys unipinna** (Gray). Hawaii; Tahiti; Vavau; Fiji; Palau Is.; East Indies.

Family PLATYCEPHALIDÆ.

PLATYCEPHALUS Bloch.

1379. **Platycephalus punctatus** Cuvier & Valenciennes. Vanicolo; Guam (Seale, Bishop Museum, 1901, 129); East Indies.

1380. **Platycephalus otaitensis** (Parkinson). Tahiti.

Cottus otaitensis Parkinson, in Cuvier & Valenciennes, Hist. Nat. Poiss., iv, 241, **Tahiti.**

1381. **Platycephalus quoyi** Bleeker. New Guinea (Macleay); East Indies.

1382. **Platycephalus tentaculatus** Rüppell. Palau Is.; East Indies.

1383. **Platycephalus nematophthalmus** Bleeker. New Guinea (Macleay); East Indies.

1384. **Platycephalus serratus** Cuvier & Valenciennes. New Ireland (Peters, Berl. Mon., 1876, 839); East Indies.

1385. **Platycephalus variolosus** Günther. Samoa.

Platycephalus variolosus Günther, Fische der Südsee, 167, taf. cix, fig. a, **Samoa.**

1386. **Platycephalus isacanthus** Cuvier & Valenciennes. New Guinea; East Indies.

INSIDIATOR Jordan & Snyder.

1387. **Insidiator pristiger** Cuvier & Valenciennes. New Guinea; East Indies.

1388. **Insidiator bataviensis** Bleeker. Ponape (Günther, Fische der Südsee, 167); East Indies.

1389. **Insidiator spinosus** (Schlegel). New Guinea (Bleeker); Japan.

Family BEMBRADIDÆ.

BEMBRADIUM Gilbert.

1390. **Bembradium roseum** (Gilbert). Deep seas of Hawaii.

Family HOPLICHTHYIDÆ.

HOPLICHTHYS Cuvier & Valenciennes.

1391. **Hoplichthys citrinus** Gilbert. Deep seas of Hawaii.

1392. **Hoplichthys platophrys** Gilbert. Deep seas of Hawaii.

Family PERISTEDIIDÆ.

PERISTEDION Lacépède.

1393. **Peristedion engyceros** Günther. Deep seas of Hawaii.

1394. **Peristedion hians** Gilbert & Cramer. Deep seas of Hawaii.

1395. **Peristedion liorhynchus** Günther. Admiralty Is. (Fish. Challenger, 1880, 46).

Family CEPHALACANTHIDÆ.

CEPHALACANTHUS Lacépède.

1396. **Cephalacanthus orientalis** (Cuvier & Valenciennes). Hawaii; New Guinea; Waigiu; Tahiti (Seale); East Indies.

Family GOBIIDÆ.

ANALYSIS OF GENERA OF GOBIIDÆ FOUND IN THE SOUTH SEAS.

[This table is quite tentative, many of the genera named being of uncertain boundaries and doubtful value.]

A. Soft dorsal and anal free from the caudal; no pit above the opercle.
 B. Spinous dorsal present; ventral fins well developed.
  C. Ventral rays, I, 5.
   D. Ventral fins more or less divided.
    E. Eleotrinæ: Ventral fins wholly separate; pectorals normal; eyes normal.
     F. Body scaly.
      G. Vomer with teeth; a caudal ocellus; scales small...Bostrychus
      GG. Vomer without teeth.
       H. Scales small (fewer than 50).
        I. Sides of head naked; one or more dorsal spines produced.................................Valenciennea
        II. Sides of head scaly; none of the dorsal spines produced; head depressed.
         J. Preopercle with a small hook or antrorse spine at its angle..................................Eleotris
         JJ. Preopercle unarmed ....Guavina
       HH. Scales moderate or large (fewer than 50).
        K. Snout broad, flat, depressed; sides of head scaly ....Ophiocara
        KK. Snout moderate.
         L. Top of head with bony crests; a black spot at base of pectoral.................................Butis
         LL. Top of head without crests.
          M. Sides of head scaly; scales large.
           N. Sides of head with vertical series of small cirri; lower jaw heavy; body robust ....Gobiomorphus
           NN. Sides of head without cirri.
            O. Preopercle with 2 or 3 rather strong upturned spines; body robust..............Asterropterix
            OO. Preopercle unarmed; body compressed, the form and habit similar to that of *Fundulus;* head pointed, depressed..Hypseleotris
          MM. Sides of head naked; preopercle unarmed.
           P. Nuchal region entirely naked ....Eviota
           PP. Nuchal region fully scaled ....Trimma
     FF. Body entirely naked, slender, and elongate.
      Q. Dorsal fins separate, the second moderate ....Hetereleotris
      QQ. Dorsal fins connected, the second many-rayed; chin very prominent; tongue notched:.........Vitreola
    EE. Periophthalminæ: Ventral fins partly united at the fleshy base; pectoral with a scaly muscular base; eyes more or less stalked; scales very small, cycloid; tongue short, rounded, adnate; isthmus broad.
     R. Dorsal rays X to XV-12; teeth not horizontal and not exserted.
      S. Scales minute (80 to 100)..Periophthalmus
      SS. Scales larger, about 55...Periophthalmodon
   DD. Gobiinæ: Ventral fins completely united; pectoral without scaly muscular base; eyes not erectile.
    T. Ventral fins not adnate to the belly, in a short rounded disk; upper teeth not movable.
     U. Body scaly.
      V. Vomer without teeth.
       W. Teeth not all in one series in each jaw.
        X. Caudal fin not lanceolate nor greatly produced; teeth all simple, no barbels.
         Y. Cheeks and opercles each well scaled.
          Z. Scales small; pectoral with silky rays above ....Chlamydes
          ZZ. Scales large; tongue notched; pectoral without silky rays.............................Gnatholepis
         YY. Cheeks naked; opercles scaly; scales of body large..Vaimosa
         YYY. Cheeks and opercles naked.

a. Scales large, ctenoid; dorsal and anal fins short.
b. Tongue truncate or rounded at tip; isthmus rather broad; lower jaw usually not strongly projecting.
c. Pectoral without silk-like rays above.
d. Preopercle with 2 small hooked spines at angle; dorsal spine rigid .... OPLOPOMUS
dd. Preopercle unarmed; shoulder-girdle without fleshy slips; dorsal spines slender.
e. Dorsal spines 7 .... ABOMA
ee. Dorsal spines 6.
f. Head almost spherical; body short and plump; small canines present .... PARAGOBIODON
ff. Head not spherical.
g. Body before dorsal fin largely naked; head very large; mouth subvertical .... ZONOGOBIUS
gg. Body before dorsal chiefly scaled.
h. Ventrals short, cup-like; body elongate; head depressed; small canines present .... VAILIMA
hh. Ventrals well developed.
i. Head very large, with cross-lines of minute cirri (as in *Gobiomorphus* and in *Mars*) .... DROMBUS
ii. Head without cross-lines of tubes or cirri .... RHINOGOBIUS
cc. Pectoral fin with several free silk-like rays above .... GOBIUS
bb. Tongue emarginate at tip.
j. Pectoral with free silk-like rays; dorsal spines, 6; mouth moderate .... MAPO
jj. Pectoral without free silk-like rays above; mouth large, oblique, the chin very prominent .... GLOSSOGOBIUS
aa. Scales 36 or more; pectoral without silk-like rays.
k. Tongue emarginate; lower jaw projecting; mouth large .... CHÆNOGOBIUS
kk. Tongue entire (so far as known).
l. Shoulder-girdle with fleshy slips or flaps; dorsal and anal short, of about 11 or 12 rays; scales moderate, ctenoid; preorbital region broad; tongue adnate to floor of mouth; fresh-water species.
l'. Cheeks naked .... AWAOUS
l''. Cheeks closely scaled .... EXYRIAS
ll. Shoulder-girdle without fleshy flaps; dorsal and anal long (15 to 20 rays).
m. Body opaque; caudal rounded; dorsal spines 6.
n. Scales moderate (50 to 60), ctenoid; lower jaw with small canines .... AMBLYGOBIUS
nn. Scales minute, cycloid; no canines; jaws not opening widely .... CRYPTOCENTRUS
mm. Body elongate, translucent; caudal emarginate; mouth small; dorsal spines seven .... VITRARIA
XX. Caudal fin lanceolate, much produced; no barbels at chin.
o. Eye with fleshy cirrus above .... PSELAPHIAS
oo. Eye without cirrus.
p. Mouth very large, the maxillary produced backward somewhat as in *Opisthognathus* .... WAITEA
pp. Mouth moderate; no canines; soft dorsal and anal moderate, of 12 to 20 rays.
q. Outer teeth moderately enlarged; upper pectoral rays silk-like .... GOBIICHTHYS
qq. Outer teeth setaceous and movable; lower jaws flat and thin; no silk-like rays .... GOBIONELLUS
WW. Teeth all uniserial; canines present; soft caudal more or less pointed.
r. Scales rather large (25 to 35); soft dorsal and anal short .... GOBIOPTERUS
rr. Scales moderate (40 to 50); soft dorsal and anal of about 23 rays .... APOCRYPTODON
rrr. Scales very minute, about 200; soft dorsal and anal of about 30 rays .... PSEUDAPOCRYPTES
VV. Vomer with about 3 large blunt teeth; head with numerous lines of small cirri running in various directions scales rather small; fins moderate .... MARS
UU. Body naked or very nearly so.
s. Body rather elongate, not greatly compressed.
t. Dorsal spines 6; snout very blunt; soft dorsal longer than anal .... KELLOGGELLA
ss. Body greatly compressed and elevated.
u. Canines present, small .... GOBIODON
uu. Canines wanting .... PSEUDOGOBIODON
tt. Ventral fins short, round, cup-shaped, adnate to the belly; outer teeth more or less flexible, peculiarly formed.
v. Body scaly or chiefly so.
w. Teeth clavate, not pointed.
x. Scales small (50 to 80); body well scaled .... SICYOPTERUS
xx. Scales large, about 40; trunk partly naked anteriorly .... MICROSICYDIUM
vv. Body naked or largely naked; upper front teeth tricuspid .... LENTIPES
AA. GOBIOIDINÆ. Soft dorsal and anal very long, joined to the caudal; body eel-shaped, the scales minute or wanting no pit above opercle; eyes minute; teeth very long, curved; dorsal moderate, its rays about VI, 16 .... GOBIOIDES

BOSTRYCHUS Lacépède.

Electrids with vomerine teeth, as in the American genus *Philypnus*.

1397. **Bostrychus sinensis** Lacépède. Oualan; Kanathia, Fiji; East Indies; China.

VALENCIENNEA Bleeker.

1398. **Valenciennea muralis** Quoy & Gaimard. Tucopia, Vanicolo; Fiji; East Indies; Australia.

1399. **Valenciennea longipinnis** Lay & Bennett. Fiji (Günther), Riukiu Is.

Eleotris longipinnis Lay & Bennett, Zool. Beechey's Voyage, 64, tab. 20, fig. 30, Riukiu Is. Günther, Fische der Südsee, 190, Fiji.

Recorded by Günther from Fiji. The species is very close to *Valenciennea muralis*, with which it is identified by Jordan & Snyder (Proc. U. S. Nat. Mus., xxiv, 42) from the Riukiu Islands. Dr. Günther, however, regards it as distinct.

1400. Valenciennea strigata (Broussonet). Tahiti; Fiji; Samoa (Günther); East Indies.

Gobius strigatus Broussonet, Ichth., Dec. 1, pl. 1, 1782, Tahiti.
Eleotris strigata, Günther, Fische der Südsee, 190, taf. 111, fig. E, Fiji, Samoa, Tahiti.

The species was not taken by us at Samoa. It is easily recognized by the much longer dorsal and anal fins. Dorsal vi, i, 18; anal i, 16.

1401. Valenciennea violifera Jordan & Seale, new species. *Ta'oto.* Samoa. (Pl. lii, fig. 2.)

Head 3.45 in length; depth 5; eye 5 in head; dorsal vi-i, 12; anal i, 12; scales 75; interorbital 5.50; snout 3.10.

Body elongate, compressed; snout rounded; mouth large, lips rather thick, the angle of the jaws under middle of eye; jaws with 2 rows of small, curved, sharp-pointed teeth; opercle and preopercle entire; gillrakers short, soft, with elongate point on lower limb; caudal peduncle strong, its depth 2.50 in head; origin of spinous dorsal on line with base of ventrals; third and fourth spines of first dorsal slightly elongate, 1.14 in head; base of soft dorsal equal to head, its longest ray about 2 in head; base of anal 1.20 in head, its longest ray 1.25 in base, its origin midway between base of caudal and posterior margin of eye; pectoral 1.30 in head; ventral 1.90 in head; caudal rounded, equal to head.

Life colors of a specimen from Apia (very young), very pale olive, with two faint livid blue lateral streaks connected with cross lines of the same color; fins all pale; dorsal tipped with black.

An adult specimen from Pago Pago was light olive, mottled with pale pinkish brown; a pinkish brown stripe from lower pectoral axil straight to base of caudal; six violet spots darker edged, on side of head; one on base of pectoral; dorsal light reddish, a jet black spot edged with white on the tips of the longest spines; caudal pale, mottled light green and pink at base; the larger examples have a black spot on upper part of caudal; blue spots plainer; anal light yellow; pink brown at base and dark-edged, often pink at base and edge; ventral and pectoral pale; pectoral without dark in axil.

Color in spirits dull yellowish white with tint of brown; some specimens show traces of 7 dusky blotches along back; five or six bluish white spots on opercle and cheek; an indistinct brownish line from axil of pectoral to caudal; belly and chin bluish white; third and fourth spines of dorsal tipped with black; spinous and soft dorsal with indistinct blue lines; caudal (except in young) with a black blotch on its upper middle portion; anal with narrow dark line at margin and another near the base; some specimens show a dusky tip to caudal; pectoral and ventral unmarked.

This handsome species is common in the crevices of the coral reefs about Apia and Pago Pago. It seems to be distinct from the two species *muralis* and *sexguttata* of the western Pacific. It has the head markings of the latter with the body markings of the former.

Seven specimens from Pago Pago and 23 from Apia. Specimens also from the island of Negros, P. I., collected by Dr. Bashford Dean.

The type is no. 51771, U. S. National Museum, 4.60 inches long, from Apia.

ELEOTRIS (Gronow) Bloch & Schneider.

1402. Eleotris fusca (Bloch & Schneider). *Pa'ofu.* Samoa; Tahiti; Oualan; Fiji; Guam; Waigiu; Vanicolo; Aneiteum; Solomon Is.; New Hebrides; Borabora; Tubuai and Nukahiva (Seale); East Indies.

Fifty-three specimens from the lower course of Vaisigano River at Apia and from Gasegase River in the neighboring village of Vaimosa; 15 specimens from brackish water at Pago Pago.

This species is widely distributed through the South Seas. It is common in the sluggish waters of the lower reaches of the Vaisigano and other streams.

Eleotris sandwichensis of Hawaii, a species entirely similar in size, appearance, and habit, differs in having larger scales.

1403. Eleotris sandwichensis Vaillant & Sauvage. Streams of Hawaii.

GUAVINA Bleeker.

This genus resembles *Eleotris*, but lacks the preopercular spine characteristic of that genus.

1404. Guavina gyrinoides (Bleeker). New Guinea (Macleay); Palau Is.; East Indies.

1405. Guavina immaculata (Macleay). New Guinea.

Eleotris immaculatus Macleay, Proc. Linn. Soc. N. S. W. 1883, 69, 268, **New Guinea**

OPHIOCARA Gill.

Ophiocara Gill. Proc. Ac. Nat. Sci. Phila. 1863, 270 (*ophiocephala*).

This genus is characterized by the large scales and short depressed head, the form being like that of the genus *Ophicephalus*. Cheeks scaly.

1406. Ophiocara porocephala (Cuvier & Valenciennes). Palau Is.; Caroline Is.; New Ireland: Vanicolo; New Guinea (Macleay); East Indies.

1407. Ophiocara aporos (Bleeker). Fiji; Gilolo; Oualan; East Indies.

1408. Ophiocara cantoris (Günther). Fiji; East Indies.

1409. Ophiocara macrolepidota (Bloch). Fiji; New Guinea (Macleay); East Indies.

BUTIS Bleeker.

1410. Butis butis (Hamilton-Buchanan). New Guinea (Macleay); East Indies.

GOBIOMORPHUS Gill.

This genus contains short-bodied Eleotrids with large scales, the cheeks and opercles naked, and the cheeks with rows of papillæ.

1411. Gobiomorphus eugenius (Jordan & Evermann). Hawaii.

1412. Gobiomorphus sclateri (Steindachner). Tahiti; Samoa.

Eleotris sclateri Steindachner Ichth. Beitr., VIII, 157, 1880, **Tahiti.**

This handsomely colored little fish occurs in some abundance in the reefs about Apia and Pago Pago. We have 7 specimens from Apia and 5 from Pago Pago.

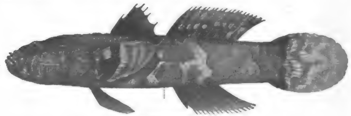


FIG. 73.—*Gobiomorphus sclateri* (Steindachner).

Life colors of a specimen from Apia, light gray, with three broad brown cross-bands; first dorsal yellowish spotted; second dorsal brown, yellowish at tip, mottled; caudal profusely spotted; anal and ventral blackish; pectoral barred; head very much mottled.

Another, from Pago Pago, was grayish white, with blackish brown transverse bands; everywhere with black points; on dorsal and caudal weak blotches of thin yellowish.

Still another, a very small specimen from Apia, was pale gray, with a black bar at base of caudal; two black dots below eye; four yellowish white cross-bars, alternating with black; a jet-black spot in axil; fins whitish, scarcely dotted.

ASTERROPTERIX Rüppell. (*Brachyeleotris* Bleeker.)

In this genus the body is short and robust, the scales large, the sides of the head scaly, without papillary ridges; paired fins not fringed. Small fishes of the coral reefs.

1413. Asterropterix semipunctatus Rüppell. Hawaii; Samoa; Tahiti; Palau Is.; East Indies. (Pl. XXXVI, fig. 1.)

This small fish is rather common in the crevices of the reefs about Samoa. We have 55 specimens from Apia and 1 from Pago Pago. The blue spots, distinct only in the largest examples, are subject to much variation.

Life colors of an Apia specimen—a compressed eleotrid with scaly head, large scales, and filamentous first dorsal—dark olive-brown; a dark bar below eye; base of spinous dorsal blackish; soft dorsal and anal dark gray; dorsal paler on upper half; caudal gray; ventral dark gray.

Another from Apia was brownish black with obscure markings, and still another had the head with pale blue spots, edged with darker; pectoral bright olive, dusky at base; caudal light brownish, with black spots above, ocellated with gray and some black below; fins dusky.

HYPSELEOTRIS Gill.

Hypseleotris Gill, Proc. Ac. Nat. Sci. Phila. 1863, 270 (*cyprinoides*).
Giuris Sauvage, Bull. Soc. Philom. 1879, 15 (*vanicolensis;* no definition).
?*Carassiops* Ogilby, Proc. Linn. Soc. N. S. W. 1897, 784 (*compressus*).
Caulichthys Ogilby, Proc. Linn. Soc. N. S. W. 1897, 784 (*guntheri*).

This genus is made up of handsome fresh-water fishes, with the appearance and habit of *Fundulus*, swimming freely in the water, not lying on the bottom as is the habit with most gobies.

The genus *Caulichthys* Ogilby, based on *Eleotris cyprinoides*, is synonymous with *Hypseleotris* of Gill.

1414. Hypseleotris guntheri (Bleeker). *Malu vai.* Streams of Samoa, Oualan, and Fiji.

Eleotris cyprinoides Günther, Cat., III, 118, **Oualan**; not of Cuvier & Valenciennes.
Asterropteryx guntheri Bleeker, Ver. Med., XI, 1876, after Günther.
Eleotris guentheri Günther, Fische der Südsee, 186, taf. 118, fig. A, Oualan, Savaii, Fiji.

We have about 100 specimens from Vaisigano, Gasegase, Vailima, and other streams about Apia. The native name is *malu vai.*

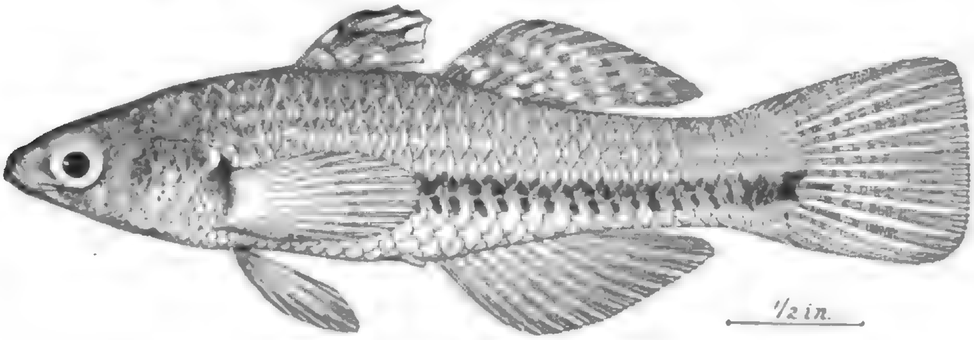


FIG. 74.—*Hypseleotris guntheri* (Bleeker).

This handsome goby is found in abundance in all the fresh waters of Upolu. Unlike others of this group it does not lie on the bottom, but swims freely. In appearance, as in habits, it has much in common with cyprinodont fishes.

A specimen from Apia showed no bright colors; a black lateral band, pectoral black, a black spot on caudal. It agrees fairly well with Günther's short account of the species.

1415. Hypseleotris vanicolensis (Sauvage). Vanicolo.

Eleotris (*Giuris*) *vanicolensis* Sauvage, Bull. Soc. Philom. 1880, 54, **Vanicolo.**

1416. Hypseleotris macrolepidotus (Bloch). Palau; Fiji; New Hebrides; East Indies.

1417. Hypseleotris godeffroyi (Günther).

Eleotris godeffroyi Günther, Fische der Südsee, 188, **Raiatea, Tahiti.**

A diminutive fish of the coral reefs, not seen by us.

EVIOTA Jenkins.

Eviota Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (1903), 501 (*epiphanes*).

This genus contains Eleotrids of diminutive size, none (except *E. abax*) an inch in length, abounding in the pools on the coral reefs and in the heads of corals. The species are very numerous about Samoa. Much of our large collection was obtained by a native boy named Afele, who would dive for the coral heads and crack them in a boat, "The Coral Queen," picking up the little fishes from the deck.

The fringing of the ventral rays and lower rays of the pectorals is a characteristic of this genus. It is especially distinguished from *Asterropteryx* by the naked sides of the head and by the entire preopercle.

The earliest known species of this genus and much the largest in size is *Eviota abax*, described by Jordan & Snyder, from Misaki, in Japan.

1418. Eviota epiphanes Jenkins. Hawaii.

1419. Eviota miniata (Seale). Guam.

Eleotris miniatus Seale, Occ. Papers Bishop Museum, I, no. 3, 1901, 125, Guam.

1420. Eviota zonura Jordan & Seale, new species. *Lili.* Samoa.

Head 3.50 in length; depth 4.50; eye 3 in head; dorsal VI,11; anal 9; scales 28.

Body elongate, compressed; anterior profile rounded; caudal peduncle 2 in head; mouth of moderate size; angle of mouth below middle of eye; small sharp-pointed teeth in jaws; males with prominent papillæ near origin of anal, the females with a sac; distance from origin of spinous dorsal to snout 2.50 in length of fish without caudal; height of spinous dorsal about equal to its base; base of soft dorsal 1.25 in head, its longest ray 1.50 in head; origin of anal under second dorsal ray, nearer to base of caudal than to eye, length of its base 1.75 in head; pectoral longer than head, the tip on a line with first anal ray, about equal to length of ventrals; ventrals have their origin directly below the base of pectorals, their posterior extremity extending to base of anal papillæ; caudal rounded, 1.14 in the head.

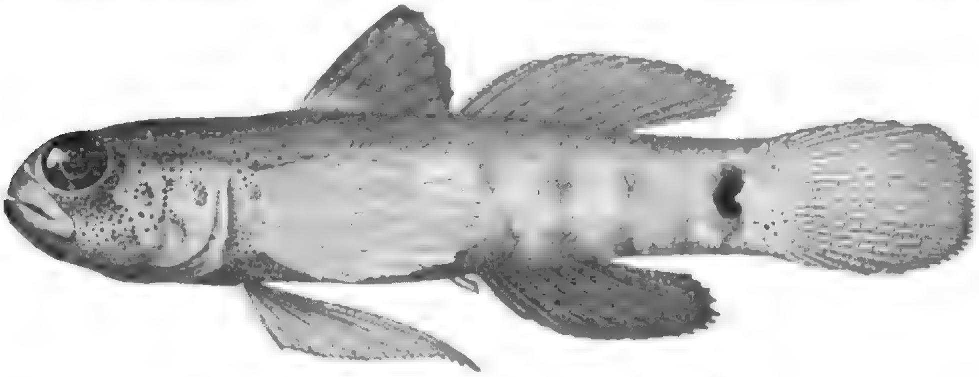


FIG. 75.—*Eviota zonura* Jordan & Seale, new species. Type.

Life colors of a specimen from Apia, olive, with orange-brown cross-bars; a black bar before base of caudal; fins brown dotted, the anal with blackish half bars at base. Length three-fifths of an inch.

A specimen from Pago Pago was bright grass-green, with round orange spots on head; scales on body edged with orange; four or five faint dark cross-bars (not plain at base of anal); a large blackish bar-like spot just before base of caudal; first dorsal dusky, mottled with orange; second dorsal pale, with rows of orange spots; caudal dusky below, pale green above, with some orange spots; anal dusky, mottled with orange; pectoral and ventral pale green. Another specimen from Pago Pago was translucent bluish green; small orange spots and irregular black dots.

Color in spirits, yellowish white, a distinct black spot on caudal peduncle, three scales from base of caudal fin; six dusky bands extending a short distance vertically up from base of anal fin; these are usually darker at base of fin; shadings of dark spots on sides and top of head (this varies greatly and is absent in some specimens); caudal fin black; spinous dorsal at anterior base is white; the upper two-thirds and posterior base is black; soft dorsal shaded slightly with dusky; caudal with indications of many narrow vertical lines, the fins white.

Of this species we have 16 specimens from Apia and 28 from Pago Pago. The type is no. 51776, U. S. National Museum, seven-eighteenths of an inch in total length.

1421. Eviota prasites Jordan & Seale, new species. *Lili.* Samoa.

Head 3.20 in length; depth 4; eye 3.50 in head; dorsal VI, 9; anal 9; scales 22.

Body elongate, compressed; caudal peduncle 2 in head; mouth of moderate size, the lower jaw slightly protruding; angle of jaw under anterior of pupil; small, sharp-pointed teeth in jaws; intromittant organ of males prominent; distance from origin of spinous dorsal to snout 2.75 in length of fish without caudal; anterior dorsal spines more or less elongate, sometimes very much longer than head, this elongation perhaps confined to the males, as in others the spines are shorter; base of soft dorsal about equal to its longest rays; pectoral slightly longer than head; ventral of equal length or less than pectoral, its origin posterior to origin of pectoral; caudal rounded, about 1.50 in head.

Life colors of a specimen from Pago Pago called *lili*, translucent yellowish white with brown pink points (under microscope rose red spots with brown pigment specks) arranged along dorsum and very weakly in narrow transverse bars on sides; all fins rosy; eye with two greenish yellow longitudinal bands, dorsal one continued on forehead. Another specimen from this locality was very pale grayish with dark specks and markings.

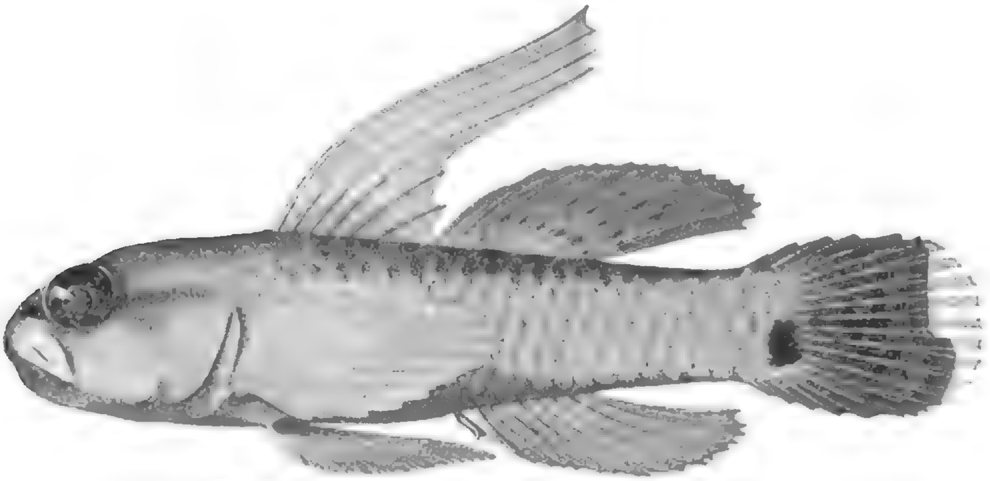


FIG. 76.—*Eviota prasites* Jordan & Seale, new species. Type.

Color in spirits, yellowish white, the margin of the scales shaded with fine black dots; a distinct black spot on lower posterior portion of caudal peduncle at base of caudal; usually a more or less distinct dusky blotch above this spot on the upper base of the caudal; a black stripe from upper posterior part of opercle through the eye and around snout; another black stripe around lower lip; a dusky blotch in upper axil of pectoral; darker shadings along the back, taking the form of more or less regular black spots along base of the dorsal; six indistinct dark band-like spots along the base of anal and under part of caudal peduncle; all the fins excepting the pectoral, which is white, have a dusky shading of fine dots; the spinous and soft dorsal have dark spots arranged in regular longitudinal lines, about four of these lines on the soft dorsal; caudal with five bands of dusky formed by separated dusky spots.

Five specimens from Pago Pago. The type is no. 51768, U. S. National Museum, length 1 inch.

1422. Eviota afelei Jordan & Seale, new species. Samoa.

Head 3.20 in length; depth 4.20; eye 3.40 in head; scales 27; dorsal VI, 10; anal 8.

Body elongate, compressed, the anterior profile rounded, the jaws equal; depth of caudal peduncle 2 in head; angle of jaws under middle of eye; sharp-pointed teeth in jaws; the inner row of lower jaw seems to have enlarged, curved canine-like teeth; nasal tubule distinct; origin of spinous dorsal slightly posterior to line with origin of ventrals, its longest spine 1.50 in head; the base is greater than the height of fin; base of soft dorsal 1.10 in head, its longest ray equal to base; pectorals slightly greater than length of head; base of anal about equal to its longest ray; pectoral reaching to a line with base of anal; origin of dorsal nearer base of anal than tip of snout; origin of ventrals posterior to origin of pectorals, their length about equal to pectorals; caudal rounded, its length 1.20 in head.

Color in spirits, whitish, the margin of scales shaded with minute dusky dots; 9 distinct dusky spots along lower side of body—3 on caudal peduncle, 3 at base of anal fin, and 3 on belly; all of these tend to extend more or less up on the side of body where they fade out; the abdominal blotches are much the largest; side of head with about 6–8 irregular brown blotches more or less run together, one forming a band from eye to angle of mouth, two on the opercle, one or two on preopercle, and two or three just posterior of eye; nuchal region shaded darker; an indistinct dusky blotch on the caudal peduncle, three scales from base of caudal; some specimens with faint traces of dusky spots along the back; spinous dorsal and anal dusky, other fins only slightly shaded with minute dark dots like those on the margin of the scales.

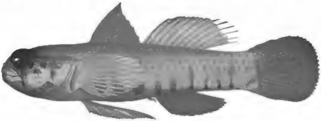


FIG. 77.—*Eviota afelei* Jordan & Seale, new species. Type.

Ten specimens from Pago Pago, collected from coral heads by the Samoan boy, Afele, of Pago Pago. Type no. 51763, U. S. National Museum, five-eighths inch long, from Pago Pago.

1423. Eviota smaragdus Jordan & Seale, new species. Samoa.

Head 3.75 in length; depth 4.50; eye 3 in head; scales 24; dorsal VI, 10; anal 9.

Body elongate, compressed; the anterior profile of head rounded, the jaws equal; caudal peduncle 1.75 in head; jaws with small, sharp curved teeth; anterior rays of first dorsal elongate and filiform, except in young, their longest ray when fin is prone extending to middle of soft dorsal; base of soft dorsal equal to length of head, the longest ray 1.75 in head; base of anal 1.20 in head, its longest ray 1.50; pectorals slightly greater than length of head, ventrals having their origin below base of pectorals and extending to the anal papillæ; caudal rounded, 1.10 in head.

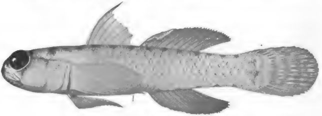


FIG. 78.—*Eviota smaragdus* Jordan & Seale, new species. Type.

One specimen from Pago Pago in life was greenish yellow, with bright red spots and black points; reddish spots on caudal; two black spots at the nape.

Another specimen from Pago Pago was translucent, bright grass-green, with orange-brown specks on each scale along side; 12 orange-brown short bars along back, on each side of dorsal a black bar across nape and opercle and one behind eye; orange dashes under chin; a scarlet bar, sharply defined, across base of pectoral, deep green before it; five dark violet-brown bars across base of anal; dorsal brownish, the spines dull orange, the first soft ray dusky; caudal greenish barred with orange; anal violet brown; pectoral and anal green; throat deep blue-green, with a heart-shaped orange spot; anal papilla deep green.

Color in spirits, yellowish white, the scales usually margined with black dots; a characteristic marking is the presence of two large distinct black spots on posterior nuchal region above the opercle; in addition to these spots there are 13 dark band-like spots on the dorsal surface; nuchal region and upper part of head shaded with small dots; 6 indistinct dark blotches along base of anal and lower margin of caudal peduncle; a dusky band-like blotch at base of caudal fin; excepting the pectorals all the fins have a slight shading of dusky, the anal being the darkest; the caudal with four dusky bands.

Twelve specimens from Pago Pago. The type is no. 51764, U. S. National Museum, length 1 inch.

1424. Eviota distigma Jordan & Seale, new species. Samoa.

Head 3.10 in length; depth 4.10; eye 3.18 in head; dorsal VI, 9; anal 9; scales 24.

Body elongate, compressed; caudal peduncle 2.10 in head; mouth rather small, maxillary not reaching to below middle of eye; minute sharp teeth in the jaws; intromittant organ of males prominent; origin of spinuous dorsal nearer snout than posterior axil of soft dorsal; the two anterior dorsal spines elongate and filiform, reaching when in repose the posterior axil of soft dorsal; the base of the fin 1.50 in head; base of soft dorsal 1.45 in head, the longest ray 1.75 in head; base of anal 2.80 in head, its longest ray 1.75; pectorals slightly longer than head; ventrals of about equal length and extending to tip of anal fin; caudal rounded, 1.20 in head.

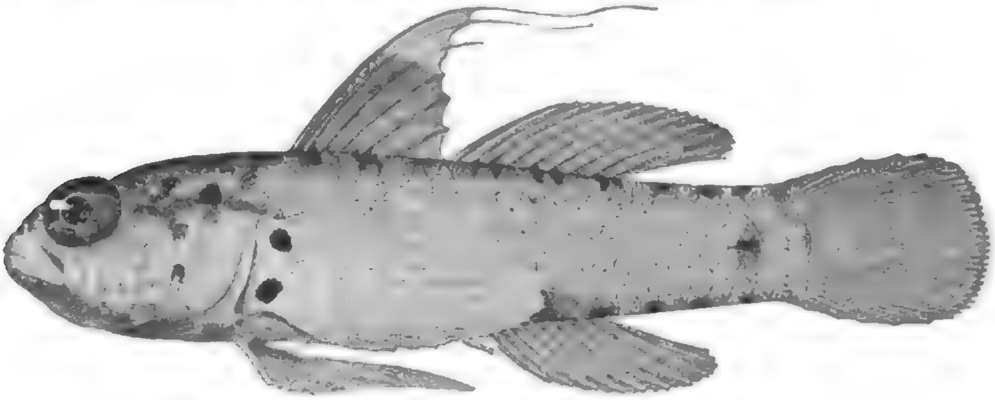


Fig. 79.—*Eviota distigma* Jordan & Seale, new species. Type.

A very small fish from the crevices of the coral reefs at Pago Pago. Easily known by the two black spots at the base of the pectoral, these rarely faint or obsolete.

Life colors of a specimen from Pago Pago, translucent gray, with faint bluish green anteriorly; small orange spots with many black points; interior blackish transverse bars showing through distinctly.

Color in spirits yellowish white, with slight shading of dusky. The type specimen has two distinct round spots on base of pectoral, a black spot on side of caudal peduncle with an indistinct vertical band through it and around peduncle; two black spots above opercle; about 10 black blotches taking the form of short bands over the back, in some specimens extending indistinctly to ventral surface; 6 dusky band-like spots along base of anal and caudal peduncle; margin of the scales usually shaded with minute brown dots; opercle and nuchal region with brown blotches, some forming more or less irregular lines; the 2 dorsal fins about equally shaded with dusky; pectoral white; caudal, anal, and ventral with dusky shadings.

Fourteen specimens from Apia and Pago Pago. The type is no. 51767, U. S. National Museum, from Pago Pago, length five-eighths inch.

1425. Eviota sebreei Jordan & Seale, new species. Samoa.

Head 3.35 in length; depth 5; eye 3.25 in head; scales 26; dorsal vi, 9; anal 10.

Body elongate, compressed; anterior profile of head rounded; jaws equal; the snout, however, more pointed than in other species of *Eviota;* caudal peduncle 2 in head; jaws with small sharp-pointed teeth, angle of jaws below middle of eye; base of spinous dorsal greater than its height, its base 1.30 in head; base of soft dorsal 1.20 in head; pectoral 1.10 in head; the ventrals slightly longer, reaching to base of anal, their origin posterior to base of pectorals; caudal rounded, 1.20 in head.

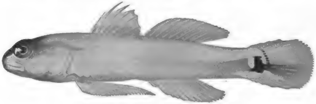


FIG. 80.—*Eviota sebreei* Jordan & Seale, new species. Type.

Color in spirits white; a wide grayish band from posterior of eye along lower part of side to caudal; a narrow brown line from posterior of eye along middle of body to caudal; a big deep black blotch on base of caudal, which extends out upon the fin; a dark line from eye down side of snout; upper half of spinous dorsal whitish, lower half dusky; soft dorsal, anal, and caudal more or less shaded with dusky; pectoral and ventral white.

One specimen, no. 51765, U. S. National Museum, from Apia, length 0.65 inch.

1426. Eviota herrei Jordan & Seale, new species. Samoa.

Head 3.10 in length; depth 3.75; eye 2.75 in head; scales 24; dorsal vi, 9; anal 8.

Body rather short and thick for a fish of this genus; anterior profile rounded, the lower jaw slightly the longer; minute round, pointed teeth in each jaw, those of upper jaw rather widely separated; caudal peduncle thick, its depth 2 in head; origin of spinous dorsal slightly posterior to a line with origin of ventrals, its height about equal to its base; base of soft dorsal equal to its longest ray; pectoral long, extending to below the 7th ray of soft dorsal; origin of anal much nearer base of caudal than tip of snout, its base less than length of its longest ray; ventrals reaching base of anal, their origin directly below and scarcely in advance of origin of pectorals; caudal rounded, 1.20 in head.

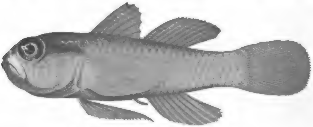


FIG. 81.—*Eviota herrei* Jordan & Seale, new species. Type.

Life colors of a specimen from Apia, gray, scales orange-edged; fins clear orange, barred with grayish.

Color in spirits whitish, with scales margined with dusky dots, giving the fish a brownish appearance; the shadings on the head with light lines reticulating more or less distinctly, and separating the marking with irregular spots, or squares or polygons; a very indistinct dusky blotch on sides of caudal peduncle, 3 scales from base of caudal; most specimens (including type) show about three indistinct longitudinal white lines on the sides; there is a dark line from posterior of eye to upper posterior margin of opercles; some specimens show 6 indistinct dusky spots along base of anal and lower surface of caudal peduncle; the two dorsal fins and the anal dusky; other fins but slightly shaded with dusky.

This species closely resembles *Eviota distigma*, differing in the larger mouth, and in having usually but one spot at base of pectoral.

Three specimens (237) from Pago Pago and five from Apia. The type is no. 51769, U. S. National Museum from Apia, length 0.75 inch.

Named for Mr. W. C. T. Herre.

1427. Eviota pruinosa Jordan & Seale, new species. Samoa.

Head 3.20 in length; depth 5; eye 3.50 in head; dorsal VI, 9; anal 8; scales 28; snout 4 in head.

Body elongate, compressed, the head rather pointed; the mouth small; angle of jaw under anterior margin of eye; opercles and preopercles entire; teeth minute, in jaws only; a distinct tube at nostril; depth of caudal peduncle 2 in head, also about 2 in its length; anal papilla distinct; origin of spinous dorsal slightly posterior to line with axil of ventrals, the longest spine 2 in head; base of soft dorsal 1.50 in head, its longest ray 1.75 in head; anal similar to soft dorsal, its base and length of rays being slightly less; pectorals extending to a line with base of soft dorsal, 1.12 in head; ventrals separate, their tips extending to anal opening; caudal rounded, 1.20 in head.

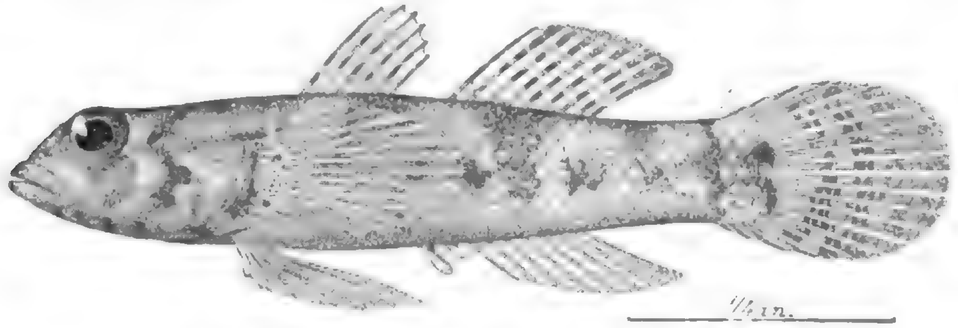


FIG. 82.—*Eviota pruinosa* Jordan & Seale, new species. Type.

Life colors of a specimen from Pago Pago, white with blackish mottlings and very faint orange yellowish dashes; a faint dusting of whitish as though frosted.

Color in spirits yellowish white, shaded with brownish; five or six dark blotches along the side rather distinct wide dusky blotch extending down from base of each dorsal fin, a distinct white stripe between the two, and a white stripe over anterior base of spinous dorsal; two dusky blotches at base of caudal; a rather black spot directly posterior to eye; cheeks and usually under part of head more or less blotched with dusky; dorsal fins marked by three or four rows of oblique dark spots; caudal with about five dusky bands; pectoral with four or five narrow indistinct lines, and usually with about four dark spots on base; anal and ventral unmarked.

Two specimens from crevices in the coral reefs at Pago Pago. The type is no. 51779, U. S. National Museum, length 0.90 inch.

TRIMMA Jordan & Seale, new genus.

Trimma Jordan & Seale, new genus of Gobiidæ (*cæsiura*).

This genus, typified by *Trimma cæsiura*, is near *Eviota*, but the region before the dorsal is fully scaled. In texture the species is firmer and less translucent.

1428. Trimma cæsiura Jordan & Seale, new species. Samoa.

Head 3.10 in length; depth 4.50; eye 3.18 in head; dorsal VI, 8; anal 9; scales 25 from posterior margin of opercles; snout 5 in head; interorbital less than pupil.

Body elongate, compressed; anterior profile rounded, the lower jaw slightly the longer, the angle under anterior margin of eye; several rows of small, sharp teeth in each jaw; opercles and preopercles entire; depth of caudal peduncle 2.50 in head; origin of dorsal fin above base of pectorals, its longest spine 1.75 in head, slightly greater than length of fin; base of soft dorsal about equal to its longest ray, 2.50 in head; base of anal 1.75 in head, scarcely equal to its longest ray; the origin of anal much nearer base of caudal than tip of snout; pectoral scarcely equal to head; ventral 1.10 in head; caudal rounded, 1.50 in head.

Life colors of the type from Apia plain bright red, with a gray spot on back of tail and gray spots on many scales of back and head; fins all bright red.

Color in spirits yellowish white, the margin of the scales thickly shaded with dusky; lighter below; 3 dark bands across interorbital space; cheek shaded with scattered dark brown dots which take the form of 2 or 3 short stripes down from the eye; snout and lips shaded with brownish; slightly darker shadings along upper margin of opercle and base of pectoral; scattered over body are a few darker dots of coloring shading into the marginal coloring of the scales; spinous dorsal yellowish, with indistinct oblique bands; soft dorsal darker with round, lighter spots; caudal yellowish white with dusky blotches· anal shaded with dusky blotches; pectoral and ventral yellowish.

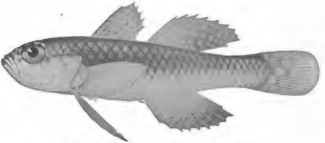


FIG. 83.—*Trimma cæsiura* Jordan & Seale, new species. Type.

One specimen from Apia, no. 31772, U. S. National Museum, length 1.26 inches.

HETERELEOTRIS Bleeker.

Heterelеotris Bleeker, Arch. Neerl. 1875, 306 (*diadematus*).

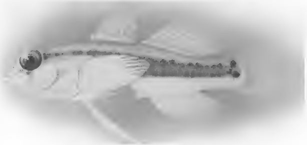
This genus contains small eleotrids of elongate form, the body translucent and scaleless. The type species *Hetereleotris diademata* of the Red Sea is near the species described below.

1429. Hetereleotris clara Jordan & Seale, new species. Samoa. (Pl. XXXVI, fig. 2.)

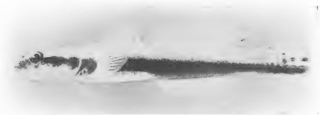
Head 4 in length; depth 6.50; eye 4.25 in head; dorsal VI, 13; anal I, 11; snout 5 in head.

Body elongate, compressed; lower jaw considerably the longer; the opening to tip of mouth is above the median line of body; the angle of jaws is under the anterior margin of eye; mouth large, with small teeth in jaws, also teeth on the palatines; tube at nostril rather distinct; opercles and preopercles not denticulate; depth of caudal peduncle 2.60 in head; origin of spinous dorsal on a line with middle of pectoral rays, its base 1.75 in head, its longest spine 3.50 in head; base of soft dorsal a third longer than head, 2.87 in length without caudal; base of anal longer than head, 3.25 in length without caudal, its origin midway between middle of eye and base of caudal, its longest ray 2.50 in head; pectorals about equal to head; ventrals separate, situated slightly anterior to base of pectorals, the tip a little more than midway to base of anal; caudal rounded, 1.20 in head.

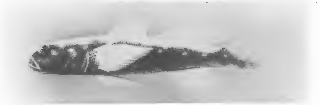
Life colors of a specimen from Pago Pago creamy white, thickly dotted with dark brown points; on each side a single broad black-brown band extending from tip of snout to tip of caudal; caudal otherwise clear with yellowish suffusion; below dead flesh-white.



1. ASTERROPTERIX SEMIPUNCTATUS RÜPPELL.



2. HETERELEOTRIS CLARA JORDAN & SEALE, NEW SPECIES. TYPE.



3. HETERELEOTRIS PHAENNA JORDAN & SEALE, NEW SPECIES. TYPE.

Color in spirits yellowish white, a broad deep brown band from tip of snout to tip of caudal on and below the median line of body; this band is broader and diffused along base of anal fin; tip of under jaw dusky; the base of anal and the dorsals with indistinct dusky band-like spots at the base of each ray and spine; three or four dark spots on caudal above the black band; posterior ray of dorsal with a black spot on its middle portion; remaining fins white, unmarked.

Two specimens from Pago Pago. The type is no. 51773, U. S. National Museum, length 1 inch.

1430. Hetereleotris phaenna Jordan & Seale, new species. Samoa. (Pl. XXXVI, fig. 3.)

Head 3.12 in length; depth 5; eye 4.50 in head; snout 4.50; dorsal VI, 10; anal I, 10; no scales.

Body elongate, compressed, snout rounded, with dull point, the lower jaw being the longer; angle of mouth under anterior half of eye; mouth rather large, with minute pointed teeth in the jaws; depth of caudal peduncle 3 in head; opercles and preopercles entire; origin of spinous dorsal slightly posterior to line with axil of ventrals; base of spinous dorsal 1.75 in head, its longest spine 2.50 in head; base of soft dorsal 1.10 in head, its longest ray 2.10 in head; base of anal 1.75 in head, its origin about midway between base of pectorals and base of caudal; pectorals scarcely equal to length of head; origin of ventrals below axil of pectoral, their tips reaching to anal opening; ventrals separate, joined at base; caudal long, its rays graduate to tip, length greater than head.

Color in life, black below, the top of the head and the back abruptly white.

Color in spirits, the upper third of body and head white, the lower two-thirds black, the black running out on lower half of caudal fin, and the white running around tip of head, the black coloring on base of pectorals, and to some extent on sides of head taking the form of deep black spots; fins all yellowish white, except the black on lower part of caudal.

One specimen, the type, 0.75 inch, from the reef at Pago Pago, no. 51786, U. S. National Museum.

VITREOLA Jordan & Seale, new genus.

Vitreola Jordan & Seale, new genus of Gobiidæ (*V. sagitta*).

This genus is distinguished from *Hetereleotris* by the very slender, naked body and the form of the head and dorsal fin. The body is slender and perfectly translucent, the head sharply pointed, the point being formed by the very heavy lower jaw.

1431. Vitreola sagitta Jordan & Seale, new species. Samoa. (Pl. XXXVII, fig. 1.)

Head (to tip of under jaw) 3.50 in length; depth 9; eye situated on dorsal surface of head, 2 in snout; dorsal VI, 13; anal I, 13; snout 6 in head; the anterior projection of lower jaw about equal in length to snout.

Body elongate, compressed; anterior profile of head formed by the long, conical projection of the lower jaw; opening of mouth on the dorsal profile; the angle of jaws under anterior margin of eye; minute teeth in jaws and palatines, tongue deeply bilobed; the lower membrane of opercles, posterior and lower margin of preopercles, the upper and lower jaw all have distinct tooth-like fringes on their marginal membrane; depth of caudal peduncle 5 in head; origin of dorsal on line with tip of pectorals, the fin incised to one-half its depth, the anterior spines being placed much nearer each other than the posterior spines; the base of dorsal is 1.75 in length of fish without caudal; base of anal 2.75, its origin slightly nearer to base of caudal than to eye, its longest ray 3 in head; pectoral very short, about 4 in head; ventrals separate, short, 2.50 in head, their origin slightly anterior to origin of pectorals; caudal rounded, 1.90 in head.

In life, clear translucent white without dots or color of any sort.

Color in spirits white, shaded above the median line with an irregular band of brownish dots which extend from snout to base of caudal; fins white, unmarked.

Three specimens from Pago Pago. The type, 1.45 inches long, is no. 51784, U. S. National Museum.

PERIOPHTHALMUS Bloch & Schneider.

1432. Periophthalmus barbarus Linnæus. *Mano'o; Talae.* Samoa; Fiji; Waigiu, Oualan; Tonga; Palau Is.; New Guinea; Faté (Seale); East Indies. (Fig. 1, p. 174.)

Gobius barbarus Linnæus, Syst. Nat., ed. XII, 450, 1766, no locality. Pectorals fan-shaped, dorsal XII-13.

Periophthalmus koelreuteri Bloch & Schneider, Syst. Ichth., 65, 1801, locality unknown.

Periophthalmus kalolo Lesson, Voy. Coquille, III, 146, 1830, **Waigiu, New Ireland, Oualan.**

Periophthalmus argentilineatus Cuvier & Valenciennes, Hist. Nat. Poiss., XII, 191, **Oualan, New Guinea, Irawaddy R.**

Of this species we have 8 specimens from Aua, on the north shore of Tutuila, 9 from Pago Pago, 50 from mouth of Vaisigono River at Apia, and 1 from Apia collected by Dr. Lung, U. S. N., in 1890.

This extraordinary little fish is very abundant in the sluggish and brackish waters in the mouths of the streams of Samoa. It abounds especially in muddy bayous, freely leaving the water to climb bushes, to skip through the grass or to lurk under piles of stones to await the returning tide. It is exceedingly quick of movement and very tenacious of life. Specimens placed in a pail of formalin escaped when the lid was raised.

Life colors of one from a mud puddle at Apia, mottled gray; speckles on head pure white, others dull whitish; silvery cross-streaks on side, some light and a few dark streaks on body; dorsal with spots of pure bluish white below, then black, then edged with dull white; second dorsal reddish brown above, then a white band, then a black one, then dull olive reticulations around pale spots; caudal light and dark olive; anal pale grayish; ventral gray, with dusky center; upper surface black, pale edged; under side of head livid gray, with pale or white spots; pectoral dotted much like caudal.

A specimen taken in coral sand in the sea at Pago Pago was olive, back with nine dark cross-bands, unequal, some of them oblique; head and sides with gray dots and marblings; a dark bar from front of eye down and forward; one down and back from posterior part of eye; first dorsal very small, VII, with a dark bar at base; second with oblique black cross-streaks; caudal with four or five dark cross-streaks; pectoral with a black dot at base above and faint cross-streaks; ventral and pectoral pale; ventral separate. In spite of the small number of dorsal rays, this specimen is probably identical with the others of this variable species.

PERIOPHTHALMODON Gill.

This genus is close to *Periophthalmus*, differing in the shorter spinous dorsal, the ventrals mostly united in the adult.

1433. Periophthalmodon schlosseri (Pallas). Fiji; New Guinea (Ramsay & Ogilby); East Indies.

1434. Periophthalmodon australis (Macleay). New Guinea.

Periophthalmus australis Macleay, Proc. Linn. Soc. N. S. W. 1884, 334.

CHLAMYDES Jenkins.

Chlamydes Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (1903), 503 (*laticeps*).

This genus has the general character of *Gobius*, including the silk-like fringe to the pectorals, but the cheeks and opercles are covered with scales.

1435. Chlamydes laticeps Jenkins. Hawaii.

1436. Chlamydes cotticeps (Steindachner). Tahiti.

Gobius cotticeps Steindachner, Sitz. Ak. Wiss. Wien 1880, 237, Tahiti.

GNATHOLEPIS Bleeker.

Gnatholepis Bleeker, Arch. Neerl. 1875, 318 (*anjerensis*).
Hazeus Jordan & Snyder, Proc. U. S. Nat. Mus., XXIV, 1902 (1901), 51 (*otakii*).

This genus has the character of *Rhinogobius*, except that the cheeks and opercles are covered with large scales. The species are small, pale in color, and live about the coral reefs. *Gnatholepis thompsoni* is found in the West Indies, *Gnatholepis otakii* in Japan. The tongue is notched in *Gnatholepis deltoides, thompsoni, knighti*, and *otakii*. *Gnatholepis anjerensis* we have not seen, but the scanty description approaches *G. deltoides*.

1437. Gnatholepis deltoides (Seale). Guam; Samoa.

Gobius deltoides Seale, Occ. Papers Bishop Museum, vol. I, no. 3, 1901, 125, Guam.
?*Gobius anjerensis* Bleeker, Blennioiden en Gobioiden, 1850, 251, Anjer (Java).
?*Gnatholepis anjerensis* Bleeker, Arch. Neerl., IX, 318, 1875. "Caput superne lateribusque squamatum."

This species apparently differs from *Gnatholepis anjerensis* (Bleeker), the type of the genus *Gnatholepis*, in the smaller scales and more elongate body. The scanty description of the latter, with no reference to the color, renders it difficult to make a positive identification. The longer caudal, 4⅓ instead of 5 in total length, also may be distinctive.

Gnatholepis knighti from Hawaii is very close to the present species, but has smaller scales, 32-9. The coloration is very similar to that of our specimens called *Gnatholepis samoensis*.

We have 35 specimens from Apia and two from Pago Pago.

Life colors of *Gnatholepis deltoides*, from Apia, plain gray and mottled, with no color; a sharp band across head and through and below eye.

Another specimen from Apia was pale gray, a black bar at base of caudal; two black dots below eye; 4 yellowish white cross-bars, alternating with black; a black spot on middle of base of pectoral; fins whitish, scarcely dotted. Tongue notched.

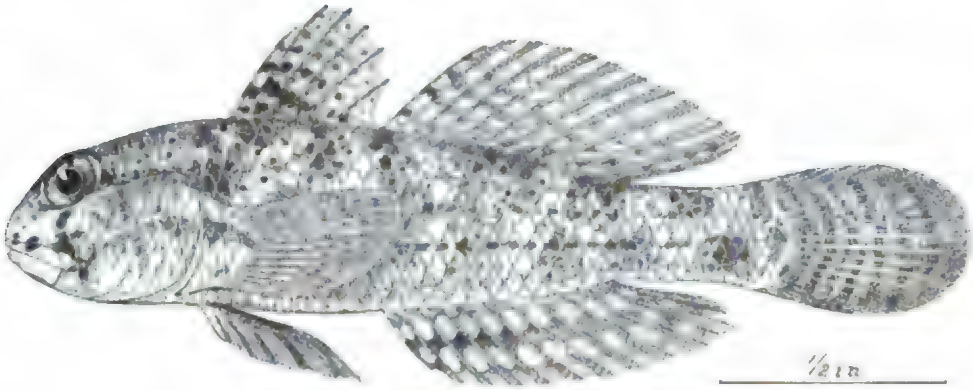


FIG. 84.—*Gnatholepis deltoides* (Seale).

1438. Gnatholepis knighti Jordan & Evermann. Hawaii.

Gnatholepis knighti Jordan & Evermann, Bull. U. S. Fish Comm., XXII, 1902 (1903), 204, **Honolulu.**

This little fish is found in abundance in coral pools and tide ponds in the Hawaiian Islands.

1439. Gnatholepis canalæ (Sauvage). New Caledonia.

Gobius canalæ Sauvage, Bull. Soc. Philom. 1881, 102, **Canala, in New Caledonia.**

1440. Gnatholepis maculipinnis (Macleay). New Guinea.

Gobius maculipinnis Macleay, Proc. Linn. Soc. N. S. W. 1884, 267. (Dorsal VII.)

VAIMOSA Jordan & Seale, new genus.

Vaimosa Jordan & Seale, new genus of Gobiidæ (*V. fontinalis*).

This genus differs from *Gnatholepis* and *Rhinogobius* in having the cheeks naked and the opercles covered with large scales. The species inhabit mountain brooks of the South Sea Islands. The type is *Vaimosa fontinalis*, from the Gasegase stream at Vaimosa in Upolu. *Gobius javanicus* Bleeker probably belongs to the same genus.

1441. Vaimosa fontinalis Jordan & Seale, new species. Samoa.

Head 4 in length; depth 4.75; eye 3.85 in head; dorsal VI, 9; anal 9; scales 37 from posterior margin of opercles; the scales are much smaller on anterior of body; head from a line with posterior of eyes unscaled; no scales on cheeks or opercles; interorbital spot equal to eye; snout equals two-thirds of eye.

Body elongate, compressed; the head bluntly rounded; mouth moderate, the angle under middle of eye; small teeth in jaws, none on vomer or palatines; opercle and preopercle entire; nuchal region concave; caudal peduncle strong, its depth 2 in head; origin of spinous dorsal over the anterior third of pectoral rays, its longest spine 2 in head; base of soft dorsal 1.20 in head, equal in length to its longest ray; base of anal 1.25 in head, equal in length to its longest ray; pectoral equals length of head; ventrals united, 1.20 in head, their origin below base of pectorals; caudal rounded, equal to length of head.

Life colors of a specimen from the Gasegase River at Apia (1.5 inches long), olive; 3 black spots at base of caudal; body with dusky shades; side of head with 3 oblique blackish stripes, meeting obscurely across throat; spinous dorsal reddish at base, the upper half black; other fins obscurely marked.

Color in spirits, dull greenish with about 7 broad irregular block-like dusky bands over back and on side, more or less connected on median line of body and near base of dorsal fins; lower third of body unmarked, but with 2 or 3 indistinct lines under chin; 5 or 6 short curved dusky lines on side of head; 1 from angle of mouth to posterior margin of preopercle where it forms a crescent-like curve upward, uniting with a line from the posterior of eye and another from below the eye; a short line from lower anterior margin of eye to middle of each side of jaw; a short line from upper posterior part of eye to opercle; a black blotch just above upper axil of pectoral; a spot on base of spinous dorsal dusky, a white line near the top, and a lighter area at base; remaining fins dusky; 2 black spots at base of caudal fin.

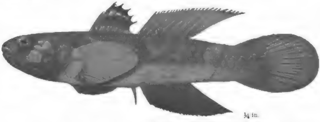


FIG. 85.—*Vaimosa fontinalis* Jordan & Seale, new species. Type.

Common in the streams of Upolu and Tutuila, with *Vailima stevensoni*, but in water less swift.

We have 23 specimens from Vaisigano River and 8 from Vailima brook and tributaries near Apia, 2 specimens from Gasegase River at Vaimosa near Apia, and 42 specimens from the stream at Pago Pago.

The type is no. 51776, U. S. National Museum, from near Apia, length 2 inches.

1442. Vaimosa notospila (Günther). Streams of Fiji.

Gobius notospilus Günther, Fische der Südsee, 173, taf. 110, fig. B, 1873, **Namusi in Viti Levu (Fiji).**

OPLOPOMUS Steindachner.

Centrogobius Bleeker, Arch. Neerl. 1875, 321 (*notacanthus*); not *Oplopoma* Girard.

This genus is characterized by the presence of a small spine on the preopercle. The dorsal spines are rigid. In other respects it resembles *Rhinogobius*.

1443. Oplopomus oplopomus (Cuvier & Valenciennes). Tahiti; East Indies.

Gobius oplopomus Cuvier & Valenciennes, Hist. Nat. Poiss., XII, 66, 1839, **Red Sea.** Günther, Fische der Südsee, 170, Philippines, Macao, Tahiti.
Gobius bitelatus Cuvier & Valenciennes, Hist. Nat. Poiss., XII, 89, 1839, **Red Sea.**
Gobius notacanthus Bleeker, Goram, 110, **Goram.**

ABOMA Jordan & Starks.

Aboma Jordan & Starks, Proc. Cal. Ac. Sci. 1895, 497 (*etheostoma*).

This genus differs from *Rhinogobius* in the presence of 7 dorsal spines.

1444. Aboma græffei (Günther). Rivers of Fiji.

Gobius græffei Günther, Fische der Südsee, 179, Viti Levu, in fresh water.

This species unknown to us is recorded by Günther and Kner from the streams of Fiji.

PARAGOBIODON Bleeker.

Paragobiodon Bleeker, Arch. Neerl. 1875, 309 (*melanosoma*).

This well-marked group is distinguished by the very chubby body, subglobular head, short cup-shaped ventrals, and by the presence of numerous short prickles or filaments on the head. The scales are large, the sides of the head naked and the fins short. The lower jaw has 2 small canines. The resemblance of these species to *Gobiodon* indicates no close affinity.

1445. Paragobiodon echinocephalus (Rüppell). Tonga; Samoa; Tahiti.

Gobius echinocephalus Rüppell, Atlas Fische, 136, 1828, **Red Sea.** Cuvier & Valenciennes, Hist. Nat. Poiss., XII, 134, 1839, Massuah, Red Sea. Klunzinger, Fische Roth. Meer., 475, Red Sea. Günther, Fische der Südsee, 175, taf. 108, fig. D, Samoa, Tahiti, Tonga, Meduro, Port Bowen, China Sea, Red Sea.

Gobius amiciensis Cuvier & Valenciennes, Hist. Nat. Poiss., XII, 133, 1839, **Tonga.** Sauvage, Poiss. Madagascar, 352, pl. XLI, Madagascar (figure bad, scales given by error as 38 in text).

Of this remarkable species we have 11 specimens from the coral reef at Apia, and 3 from Pago Pago. The fish is not rare in the crevices of the coral reefs. It reaches a length of little more than an inch, but all our specimens are less than an inch in length.

The genus *Paragobiodon* is separated from *Rhinogobius* by the short plump body, the globular head, the presence of papillæ on the skin of the head, by the short, cup-shaped ventrals, and by the short oblique mouth, with two small canines. The scales are large, the fins short, the first dorsal with 6 spines, and the sides of the head are without scales.

Life colors of a specimen from Pago Pago, all fins and body up to base of dorsal and pectoral black; in front of that smoky red or flesh color; finely rugose and punctate; ventrals fused to form a fleshy rugose and papillate pad.

Another specimen from Apia was in life golden-yellcw, with the fins all deep brownish black, mouth very small, lips black, iris red, head more brownish.

A third specimen from this locality differs in the yellow pectoral and ventral, the pectoral dusky at tip. (This may be a female.) A faint pale edge to anal, etc.; vertical fins deep blue-black.

1446. Paragobiodon xanthosomus (Bleeker.) Samoa.

Gobius xanthosoma Bleeker, Ceram, II, 103, **Ceram, Buru, Celebes, Amboina.**

? *Gobius waitei* Garman, Bull. Mus. Comp. Zool., XXXIX, 1903, 234, pl. 3, fig. 3, **Great Barrier Reef of Australia.**

Other specimens which we identify as *Paragobiodon xanthosomus* are yellowish brown throughout, the fins scarcely darker. Twenty-two specimens were all taken in the reef at Apia in company with *Pseudogobiodon citrinus*, which they much resemble in color.

Gobius waitei is a species of *Paragobiodon* closely resembling the present species.

ZONOGOBIUS Bleeker.

Zonogobius Bleeker, Arch. Neerl. 1875, 323 (*semifasciatus*=*semidoliatus.*)

This genus includes diminutive gobies of varied coloration, similar to *Rhinogobius* but with the nape and whole head naked, the head large, and the mouth almost vertical. Tongue pointed; pectoral without silk-like rays; teeth moderate; preopercle with a slight fringe of papillæ.

1447. Zonogobius semidoliatus (Cuvier & Valenciennes). *Mano'o.* Vanicolo; Samoa; Tonga; Huahine; East Indies.

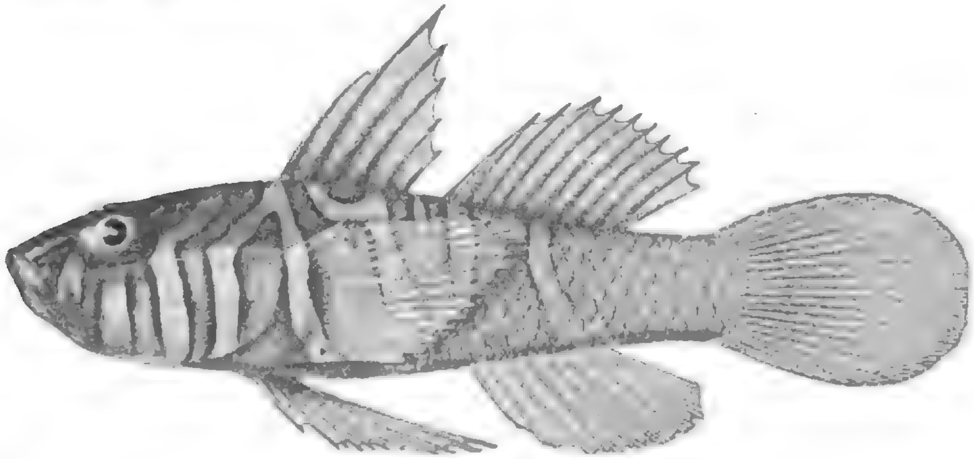


FIG. 86.—*Zonogobius semidoliatus* (Cuvier & Valenciennes).

This dainty little fish is rather common in the coral reefs about Apia and Pago Pago. It reaches a length of less than an inch. We have 18 specimens from Pago Pago and 4 specimens from Apia.

Life colors of one from Apia; brown anteriorly, olive-yellow behind; anterior parts to vent sharply marked by blunt gray cross-bars, each darker edged; fins dull olive-yellow, the dorsals with a pale and a dark band; the ventrals with a dusky center.

A specimen from Pago Pago was clear olive, paler behind; anterior parts to middle of soft dorsal with seven bluish white dark-edged cross-bands, the one behind eye forking above, the next forking below; both dorsals finely checked, bluish and pale orange; anal dark, pale edged; caudal yellowish; ventral mesially dusky; ventral and pectoral pale olive. The first dorsal of this specimen is filamentous.

Another specimen from Apia was greenish, with orange stripes alternating with bluish ones; fins dull golden.

VAILIMA Jordan & Seale, new genus.

Vailima Jordan & Seale, new genus of Gobiidæ (*stevensoni*).

This genus consists of gobies allied to *Rhinogobius* with long bodies, depressed head and peculiar physiognomy, the ventral fins short and rounded. It is near *Rhinogobius*, but is distinguished by the more elongate body, the low mouth with two small canines, and the short, cup-shaped ventrals. Scales large; head scaled above only; dorsal VI, 10; anal 11.

1448. Vailima stevensoni Jordan & Seale, new species. *Pa'ofu.* Samoa.

Head 4.50 in length; depth 5.75; eye 3.50 in head; dorsal VI, 10; anal I, 10; scales 34 from posterior margin of opercles; snout 3; interorbital concave, 3.20 in head.

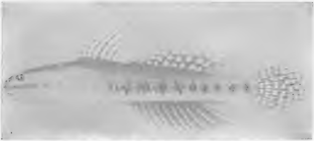


FIG. 87.—*Vailima stevensoni* Jordan & Seale, new species. Type.

Body elongate, compressed; anterior of head rounded; the upper part of snout and interorbital taken up by a broad concave groove, which extends to base of spinous dorsal; head and nape depressed, with small scales; mouth rather small, the angle under anterior margin of eye; lips broad; a row of small, sharp-pointed teeth in jaws, none on vomer or palatines; opercles and preopercles entire; gillrakers very small; depth of caudal peduncle 2 in head; origin of spinous dorsal over axis of ventrals, the third and fourth spines elongate, the fourth about a third longer than head; base of soft dorsal 3.75 in length of fish without the caudal, the posterior ray longest, 1.30 in base of fin; base of anal and its rays about equal to soft dorsal; pectorals 1.18 in head, their tips under the last spine of first dorsal; ventrals united, disk-like, short, 1.50 in head; diameter of disk about 2 in head; caudal large, rounded, its length 3.75 in length without caudal.

Life colors of a specimen from Gasegase River at Tambiyou, near Apia, olive-green; scales mottled golden and black; a black lateral band, interrupted by grayish spots; first dorsal cherry-red; spines with black spots; second dorsal reddish with dark checkers; caudal clear yellow above, then a median dash of cherry reddish, the lower half yellowish; all but upper edge closely reticulated, dark around pale spots; anal dark; ventral dirty yellow; pectoral yellow, checked with black; head with an olive lateral band.

Other specimens (female) with less red and yellow; 2 lateral bands, very distinct on head, the lowest broken into 3 dark cross-bars; anal dotted with black.

Color in spirits, a light mottled brownish, lighter below; a distinct row of black blotches along the side, these blotches about 14 in number, and all more or less connected; anterior to pectoral fin these blotches take the form of a dusky band, across the side of head and around the snout; another very indistinct dusky band about the width of eye above the blotches on sides, also extends out of upper side of head, and around upper part of snout; some specimens show about 7 whitish cross-bands over the back; spinous dorsal yellowish with about 5 oblique lines of dark dots; soft dorsal with dark lines reticulating in many ways, forming ring-like figures around white dots; caudal fin colored like soft dorsal, except that the dark lines run more regularly, forming 7 or 8 irregular cross-bands; anal uniform dusky; pectoral yellowish, crossed with about 8 narrow lines of dusky; ventral yellowish.

A beautiful little goby found on the bottom of swift streams near Apia. Its motions are remarkably lizard-like, and the pale yellow spots glisten as the fish moves. Seen in the Vaisigano River, the Gasegase River, and the Vailima Brook, from which we have 19 specimens. We have one from Pago Pago. It was abundant in the Vailima Brook on the estate of Robert Louis Stevenson, for whom the species is named.

The type is no. 51775, U. S. National Museum, from Gasegase River, at Vaimosa, Samoa, length 2 inches.

DROMBUS Jordan & Seale.

This genus, typified by *D. palackyi* from the Philippines, has the head crossed with rows of cirri as in *Mars* and in *Gobiomorphus*. The scales are much larger than in *Mars*, and the ventrals are united. There are no teeth on the vomer.

1449. Drombus tutuilæ Jordan & Seale, new species. Samoa.

Head 2.75 in length; depth 4.5; eye 3.5 in head; snout 4.2; scales rather large, about 23 from posterior margin of opercle; dorsal vi, 8; anal 8.

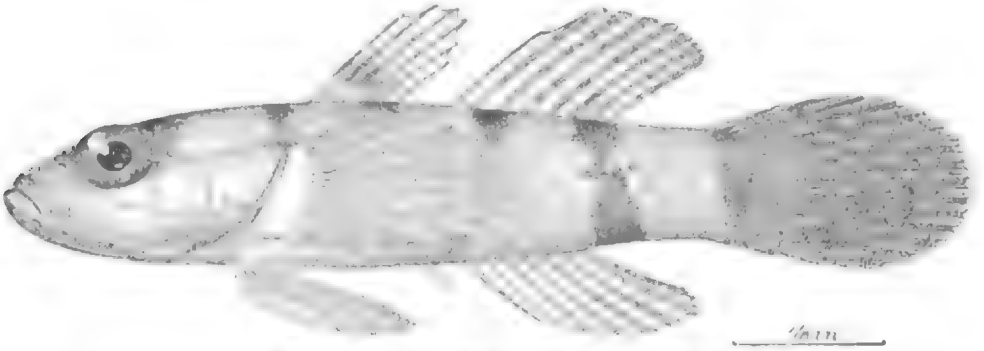


FIG. 88.—*Drombus tutuilæ* Jordan & Seale, new species. Type.

Body elongate, compressed, anterior profile rounded; lower jaw the longer, projecting; head roughened with numerous raised lines of rather large size which radiate from eye; others cross the cheek, snout, and nuchal region, these probably functioning as mucus canals; minute teeth in jaws, none on vomer or palatines; caudal peduncle 2.6 in head; origin of spinous dorsal slightly posterior to a line with axil of ventrals, the longest spine 2 in head; base of soft dorsal about equal to its longest ray, 1.75 in head; anal similar to soft dorsal, its base slightly less; pectorals rounded, rather long, the tips under base of fifth dorsal ray; ventrals united into a flat disk which reaches to anal opening; caudal rounded, about 1.1 in head.

Color in spirits, yellowish white, with 5 rather distinct vertical bands of black, the first at posterior margin of opercle, the second from posterior half of spinous dorsal, the third from anterior half of soft dorsal, the fourth from posterior half of soft dorsal obliquely down to axil of anal, the fifth at base of caudal fin; there is also a dusky bloch on nuchal region just back of eye; top of head more or less dusky; fins slightly darker than the body coloring, the dark bands of the body extending more or less upon the dorsal fins; otherwise the fins apparently without distinct markings.

One specimen from Pago Pago, type no. 51770, U. S. National Museum, length 0.75 inch.

1450. Drombus filamentosus (Sauvage). New Caledonia.

Gobius filamentosus Sauvage, Bull. Sci. Philom. 1883, 157, **New Caledonia.**

This species is said to have a multitude of small filaments on the lower side of the head and elsewhere. We therefore refer it, with much doubt, to our genus *Drombus.*

RHINOGOBIUS Gill.

(*Ctenogobius* Jordan & Snyder, not of Gill; *Coryphopterus* Gill; *Mugilogobius* Smith.)

The genus contains small gobies allied to *Gobius*, but of feeble organization and with no silky rays to the pectoral. The profile of the head is convex, anteriorly rounded. It differs from *Ctenogobius* in having the tongue convex at tip and not forked or notched.

1451. Rhinogobius corallinus Jordan & Seale, new species. Samoa.

Head 3.2 in length; depth 5; eye 3.1 in head; dorsal VI, 10; anal 8; scales 34.

Body elongate, compressed, largest at pectoral girdle; anterior profile of head obliquely pointed; mouth small, the angle under the anterior of eye; small sharp-pointed teeth in jaws; opercle and preopercle entire; caudal peduncle slender, its depth 2.5 in head, 2.2 in its length; origin of spinous dorsal slightly posterior to line with axil of ventrals; the longest spine 1.95 in head; base of soft dorsal 1.2 in head, its longest ray 2.1; anal similar to soft dorsal, its base and length of rays slightly less, the origin of the fin nearer to base of caudal than eye; pectorals greater than length of head, the tips extending to below base of fifth dorsal ray; ventrals very large, united and extending to base of anal; caudal rounded, equal to length of head.

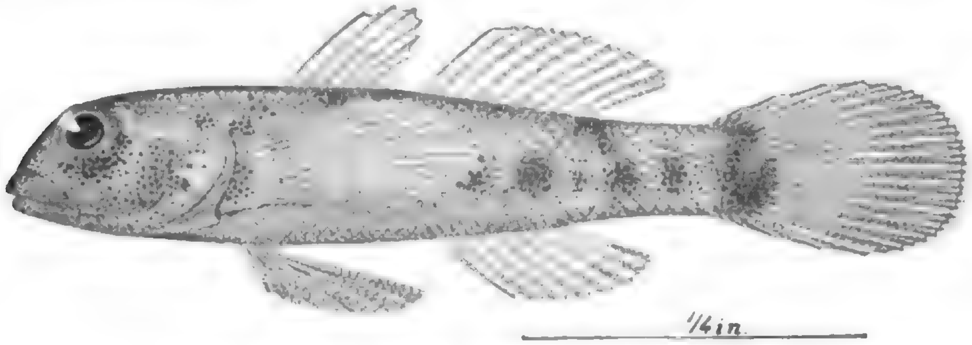


FIG. 89.—*Rhinogobius corallinus* Jordan & Seale, new species. Type.

Color in life of a specimen from Pago Pago, light gray with 3 dark brown cross-bars on back, the third black, forming 2 confluent spots at base of caudal; five quadrate black spots along side, the last being the lower part of the caudal bar; a narrower dark vertical spot between each pair; head grayish, dotted; caudal pale orange, faintly barred; dorsal pale, faintly barred with darker; pectoral, anal, and ventral pale.

Color in spirits, yellowish white with a slight shading of brown; about 9 brownish blotches along side; 3 bands of brown over the back, the first at base of spinous dorsal, the second at posterior base of soft dorsal, the third encircling base of caudal; side of head shaded with small black dots forming a more or less distinct blotch under eye; 2 indistinct blotches near upper axil of pectoral; fins unmarked, except an indistinct shading of dusky on caudal; 2 or 3 indistinct dusky spots on dorsal.

One specimen from Pago Pago, type no. 51780, U. S. National Museum, length 0.75 inch.

1452. Rhinogobius circumspectus (Macleay). New Guinea.

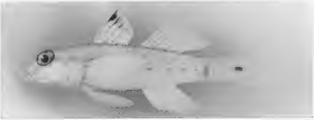
Gobius circumspectus Macleay, Proc. Linn. Soc. N. S. W. 1884, 268, **Milne Bay (New Guinea).**

1453. Rhinogobius neophytus (Günther). Samoa; Ponape; Tahiti; Huahine. (Pl. XXXVII, fig. 2.)

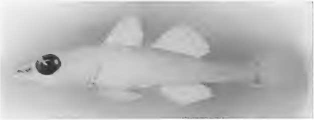
Gobius neophytus Günther, Fische der Südsee, 174, taf. 108, fig. E, **Ponape, Huahine, Apia, Tahiti.**

Three specimens from Pago Pago, one from Apia, the body more slender than shown in Günther's figure. In the slender pointed head this species differs notably from other species of *Rhinogobius.* The lower jaw is projecting; the mouth oblique and placed low, the preorbital region being very broad;

1. VITREOLA SAGITTA JORDAN & SEALE, NEW SPECIES. TYPE.



2. RHINOGOBIUS NEOPHYTUS (GUNTHER).



3. CHÆNOGOBIUS ERYTHROPS JORDAN & SEALE, NEW SPECIES. TYPE.

tongue entire, its substance translucent. *Rhinogobius muscarum* agrees with *R. neophytus* in these respects and perhaps the two should form a distinct genus.

Color in life perfectly translucent, with spots of dark orange, and some of pure black, one especially on caudal peduncle.

1454. Rhinogobius muscarum Jordan & Seale, new species. Samoa.

Head 3 in length; depth 5; eye 3.25 in head; scales about 25; dorsal VI, 9; anal 10.

Body elongate, compressed, anterior profile rounded; upper jaw slightly the longer and overhanging the lower; tongue not notched; angle of mouth under middle of eye; depth of caudal peduncle 3 in head; teeth on jaws and vomer, a clump of enlarged teeth in middle of lower jaw; tube at nostril rather distinct; anal papilla distinct; origin of spinous dorsal on a line with axil of pectoral, the height of the fin being about equal to its base; base of soft dorsal equal to its longest ray; base of anal 1.5 in head, its longest ray 2.75 in head, the origin of the fin slightly nearer base of caudal than posterior margin of eye; pectoral 1.2 in head; ventrals united and disk-shaped, the anterior margin of the membranous cup with 2 lobe-like points; ventrals rather short, not reaching to base of anal; caudal 1.2 in head.

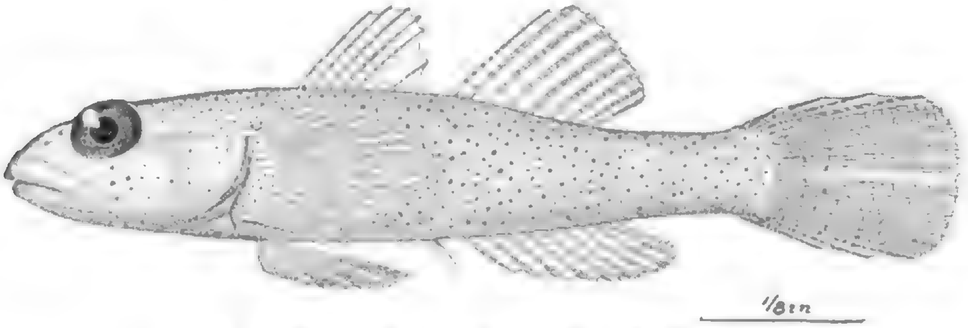


FIG. 90.—*Rhinogobius muscarum* Jordan & Seale, new species. Type.

Life colors of a specimen from Apia, translucent whitish with rather large black points and with angulated transverse narrow yellow bars; yellow markings on head.

Color in spirits, yellowish white, covering all the body with distinct round black spots slightly larger than pin points; head, thorax, and belly with fewer spots; dorsal fins showing a few scattered dark specks, caudal showing several bands of minute dots; anal with a few scattered dark spots; ventrals marked indistinctly with dusky dots; pectoral white with numerous dark dots on base.

Six specimens from the coral reef of Pago Pago. Type no. 51782, U. S. National Museum, length 0.7 inch. This species belongs to the same group as *Rhinogobius neophytus*, distinguished from typical *Rhinogobius* by the shape of snout and translucent body.

1455. Rhinogobius nebulosus (Forskål). Samoa; Papua; Palau Is.; Raiatea (Seale); East Indies.

Gobius nebulosus Forskål, Descr. Anim., 24, 1775, **Red Sea.**
Gobius criniger Cuvier & Valenciennes, Hist. Nat. Poiss., XII, 82, 1837, **Dorey Harbor, New Guinea, Malabar.**

Two specimens from the mouth of the Vaisigano River at Apia. Olive-green in life with darker blotches and spots.

GOBIUS (Artedi) Linnæus.

As now restricted the genus *Gobius* (type *Gobius niger* of Europe) includes the Old World species only, having the dorsal rays about VI–12, the scales rather large, silk-like, the teeth not large, and the tongue rounded.

1456. Gobius ornatus Rüppell. Samoa; Fiji; Yap; New Guinea (Macleay); Ponape (Kner, Novara Fische, 173); Shortland I. (Seale); East Indies.

Nape scaly; tongue rounded; upper rays of the pectoral somewhat silky. This species represents the typical genus *Gobius* and is found in shallow waters over coral sand behind the coral reefs of Apia. It is not very common. Our specimens are all immature and have but a trace of the pearly spots on the sides of the head and body. We have 4 specimens from Apia and 9 from Pago Pago.

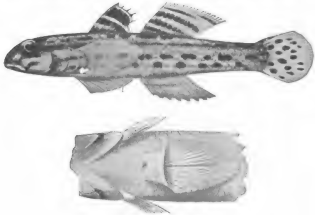


Fig. 91.—*Gobius ornatus* Rüppell.

1457. Gobius elegans Cuvier & Valenciennes. Vanicole; New Guinea.

1458. Gobius caledonicus Sauvage. New Caledonia.

Gobius caledonicus Sauvage, Bull. Sci. Philom. 1879, p. 8. **New Caledonia.**

1459. Gobius oligolepis Bleeker. New Hebrides (Seale); East Indies.

1460. Gobius concavifrons Ramsay & Ogilby. New Guinea.

Gobius concavifrons Ramsay & Ogilby, Proc. Linn. Soc. N. S. W. 1886, 12. **New Guinea.**

MAPO Smitt.

Mapo Smitt, Afh. Vet. Kong. Ak. Stockholm 1899, 543 (*soporator*).

This genus is very close to *Gobius*, differing chiefly in the emarginate tongue. One of the species is the most widely distributed of the gobies.

1461. Mapo fuscus (Rüppell). *Pa'ofu.* Samoa; Hawaii; Fiji; Tahiti; Nukahiva and Makatea (Seale); West Indies; East Indies; Panama.

Gobius albopunctatus Cuvier & Valenciennes, Hist. Nat. Poiss., XII, 57, 1837, **Ile de France.**

This species is very common throughout the South Seas, living by preference in rocky tide pools, away from the coral reefs, in the region known as "iron-bound coast." Five of our specimens are from Vailele, 5 miles east of Apia; 3 from Aua, on the north shore of Tutuila, and 49 from the rocks near Point Distress at Pago Pago.

Tongue notched; upper rays of pectoral silk-like; head broad; first dorsal VI, low.

Life colors of a specimen from Pago Pago, grayish olive, with oblong irregular spots of orange brown, lighter or darker, and forming irregular lines; a dark dash below eye; head speckled with gray and brown; dorsals spotted like body; caudal more spotted, with a dark brown marginal band and a pale tip; anal paler, also with a dark cross-shade; pectoral pale, spotted, with 3 blackish spots at base; ventral pale. A larger example was darker and browner, with traces of 3 broad cross-bands.

Those found in lava are largely black. The young have black cross-bands which vanish with age. Those from Panama and Clarion islands show a little spotting of white and a trace of a black lengthwise band.

We have thus far failed to separate the Pacific species called *Gobius albopunctatus* from the widely diffused and very common *Gobius* or *Mapo soporator* of the American coasts.

1462. Mapo crassiceps Jordan & Seale, new species. Samoa.

Head 3 in length; depth 4.75; eye 4.5 in head; dorsal VI, 10; anal 9; scales 32 counting from posterior margin of opercle; interorbital very narrow, scarcely wider than profile of eye; snout 3.75 in head; tongue emarginate.

Body elongate, compressed, largest at head, the cheeks being extremely gibbous, the head being as wide as long, and much wider than deep; cheeks and interorbital region naked; mouth rather large, with several rows of small sharp-pointed teeth; angle of jaws not reaching to below middle of eye; jaws equal in length; opercle and preopercle entire; about 12 fine silky rays on upper base of pectoral; depth of caudal peduncle 2.95; origin of spinous dorsal posterior to a line with axil of ventrals; base of spinous dorsal 2 in length; base of soft dorsal 1.75 in head, its longest ray 2.5 in head; base of anal 2.18 in head, longest ray about 2 in head, origin of anal midway between base of caudal and posterior margin of preopercle; pectorals 1.1 in head, the tips on a line with origin of soft dorsal; ventral disk 2 in head, the anterior membrane of the fin with 3 points; caudal rounded, 1.25 in head.

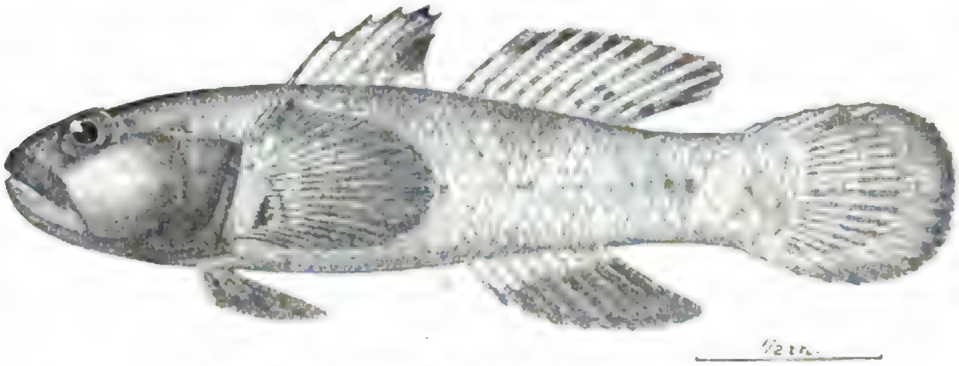


FIG. 92.—*Mapo crassiceps* Jordan & Seale, new species. Type.

Color in spirits, whitish with slight dusky wash, a small black dot just back of eye; opercle and base of pectorals usually darker; posterior part of spinous dorsal with a black blotch; soft dorsal dusky, darker in middle; caudal dusky; anal dusky, lighter on base, pectoral and ventral dusky.

Life colors of a specimen from Apia, yellowish-olive, mottled all over with blackish and grayish; grayish spots on cheeks; fins all dusky, more or less barred; axil dusky.

The species is very close to *Mapo fuscus*, differing in the tumid cheeks and plain coloration.

Nine specimens from Apia taken in the mouth of the river Vaisigano and one from the Bay of Apia. The type is no. 51777, U. S. National Museum, from Apia, length 2.1 inches.

GLOSSOGOBIUS Gill.

1463. Glossogobius vaisiganis Jordan & Seale, new species. Samoa.

Head, to tip of lower jaw, 3 in length; depth 5.5; eye 6 in head; dorsal VI, 10; anal 10; scales 29; snout 3.6 in head; interorbital very narrow, scarcely greater than pupil; eyes on dorsal profile.

Body elongate, compressed, largest at pectoral girdle; head pointed, the lower jaw the longer, about one-half the width of eye, longer than upper jaw; mouth large, the angle below the posterior margin of eye; several rows of fine sharp-pointed teeth in the jaws and on vomer; tongue deeply forked; caudal peduncle 3.25 in head; anal papilla distinct; origin of spinous dorsal slightly posterior to line with axil of ventral, its base 3 in head; base of soft dorsal 1.5 in head, its longest ray 2 in head; anal fin similar to soft dorsal, its size slightly smaller and its origin a little posterior to line with origin of soft dorsal, its origin nearer to base of caudal than to eye; pectoral extending to a line with origin of soft dorsal; origin of ventrals directly below base of pectoral, their tip extending to anal papilla; ventral fins united and with a shallow membranous cup; caudal rounded, 1.5 in head.

Life colors of a specimen from Vaisigano River, dark olive, with lighter yellowish olive; no bright colors. Dorsal VI-I, 9.

Color in spirits, olive-brown, lighter below, 7 dusky blotches along median line of sides, and about 6 narrow blackish longitudinal lines along middle of scales; a black spot on base of pectoral with a short black line below it; head more or less mottled with black blotches, some lighter dots and lines on lower jaw; spinous dorsal yellowish, a broad black band crossing its upper third; soft dorsal dusky yellow with about 5 indistinct blackish oblique bands; caudal with about 6 vertical dusky bands, the lower part of the bands being the broader; anal colored similar to soft dorsal; pectoral yellowish with indication of 5 or 6 narrow darker lines; ventrals dusky with white margin.

This species has the form, general coloration, and forked tongue of the Japanese species, *Glossogobius brunneus*, but it differs in some details of coloration, notably the presence of dark lengthwise streaks.

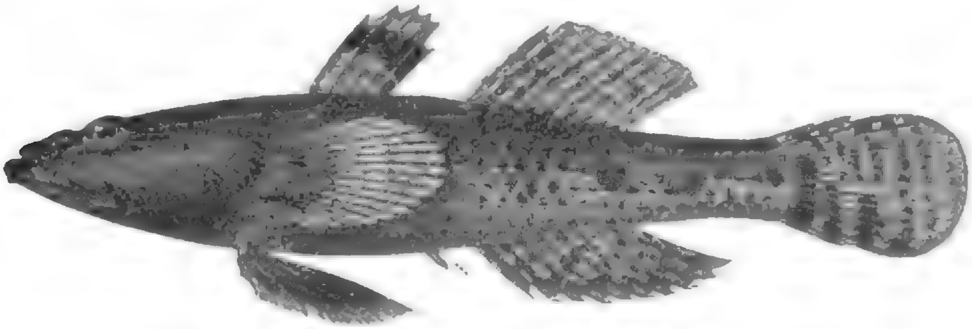


FIG. 93.—*Glossogobius vaisiganis* Jordan & Seale, new species. Type.

Four specimens from the lower reaches of Vaisigano River at Apia, and one specimen from Pago Pago. The type is no. 51774, U. S. National Museum, from Vaisigano River, near Apia, length 3 inches.

CHÆNOGOBIUS Gill.

We refer a Samoan species to this Japanese genus. It agrees with the type in the elongate body, the small scales, the projecting lower jaw, notched tongue, and in the short fins, the dorsal having but 6 spines.

1464. Chænogobius erythrops Jordan & Seale, new species. Samoa. (Pl. XXXVII, fig. 3.)

Head 3.1 in length; depth 5.5; eye 3.2 in head; dorsal VI, 9; anal 7; scales about 41 counting from posterior margin of opercle; snout 3.4 in head.

Body elongate, compressed; snout pointed, the under jaw decidedly the longer; mouth large, the angle under the anterior margin of eye; teeth in jaws in a single row, with some of the anterior ones enlarged and distinct; teeth on vomer, none on palatines; tongue notched at tip; opercle and preopercle entire; anal papilla distinct; depth of caudal peduncle 2.7 in head; spinous dorsal with its origin above base of ventrals, its longest spine 2 in head; base of soft dorsal 1.75 in head, its longest ray about 2; anal similar to soft dorsal, its base and length of rays slightly less; origin of anal about midway between eye and base of caudal fin; pectoral 1.75 in head; in the type specimen the upper 5 rays are not connected except on basal half, but they may have been torn loose accidentally; ventrals united, disk-shaped; the anterior membrane with 2 points, the diameter of disk 2 in head; caudal rounded, 1.75 in head.

Life color, pearly white above; sides darker and with black points; eye rosy around pupil; rosy longitudinal preocular bars on head.

Color in spirits, almost uniform white, with scattered fine dots like pin points, a slight dusky blotch at base of caudal, one on snout, and another posterior to eye; markings all indistinct; fins without markings, except some very fine scattered dots like pin pricks.

One specimen, from Pago Pago, type no. 51781, U. S. National Museum, length 0.6 inch.

AWAOUS Steindachner.

Les Awaous Cuvier & Valenciennes, Hist. Nat. Poiss., XII, 95, 1837 (*ocellaris*, etc.).

Awaous Valenciennes, Steindachner, Verh. Akad. Wiss. Wien 1860, 289, after Cuvier & Valenciennes, no explanation; no type named, reference to Valenciennes implied.

Chonophorus Poey, Syst. Gob., 320 1874, (*bucculentus=banana*).
Awaous Bleeker, Rev. Gob., 320, 1875 (*ocellaris*).
Trichopharynx Ogilby, Proc. Linn. Soc. N. S. W. 1897, 769 (*crassilabris*).

This genus contains large gobies of the tropical rivers, characterized by a peculiar physiognomy, and by the presence of small fleshy flaps on the shoulder-girdle; tongue adnate to floor of mouth. It is probable that the generic name *Awaous* should be adopted for this group, on the strength of its use in a subgeneric sense by Steindachner.

1465. **Awaous stamineus** (Valenciennes). Hawaii.

1466. **Awaous ocellaris** (Broussonet). *Mano'o; I'a pala.* Tahiti; Samoa; Rarotonga; Fiji, in streams.

Gobius ocellaris Broussonet, Dec. Ichth., pl. 142, 1782, **Tahiti**, coll. Solander. Cuvier & Valenciennes, Hist. Nat. Poiss., XII, 98 1837, Ile de France. Günther, Fische der Südsee, 177, taf. 108, fig. c, Samoa, Rarotonga, Viti Levu.

We have 2 specimens from the stream at Pago Pago and 20 specimens of various sizes from the Vaisigano River at Apia. The species is common in the river where the current is broad and swift. It reaches a length of 6 inches. There are scales on upper edge of cheeks and opercles, not on the whole side of head as shown in Günther's figure.

Life colors of 2 specimens from Apia, called *mano'o ia pala*, mottled green; dorsals and anal red-tinged; a large black ocellus on dorsal; caudal with 2 or 3 black bars; soft dorsal with 3 black bars; anal reddish, pale-edge; ventral reddish. Adult males nearly black with black lower fin.

1467. **Awaous crassilabris** (Günther). Rivers of Oualan; Aneiteum; Shortland I. (Seale).

Gobius crassilabris Günther, Fische der Südsee, 178, 1873, **Oualan, Aneiteum.**

This species is common in the streams of Malanesia. It was not taken by us. It resembles *Awaous ocellaris*, but lacks the black ocellus on the dorsal. It may not be different from *Awaous guamensis*.

1468. **Awaous guamensis** (Cuvier & Valenciennes). Guam.

Gobius guamensis Cuvier & Valenciennes, Hist. Nat. Poiss., XII, 103, 1837, **streams of Guam.** Sauvage, Bull. Sci. Phil. 1879, 7, Guam.

1469. **Awaous genivittatus** (Cuvier & Valenciennes). *Teli.* Rivers of Hawaii; Fiji; Samoa; Tahiti; New Hebrides.

Gobius genivittatus Cuvier & Valenciennes, op. cit., 64, 1837, **Tahiti.** Günther, Fische der Südsee, 170, taf. 910, fig. c, Tahiti, Fiji, Samoa, Hawaii.

Abundant in the quiet pools and sluggish reaches of the Vaisigano and other rivers. We have 5 specimens from Vaisigano River.

EXYRIAS Jordan & Seale, new genus.

Exyrias Jordan & Seale, new genus of Gobiidæ (*Gobius puntangoides* Bleeker).

1470. **Exyrias puntangoides** (Bleeker). Ponape; Shortland I. (Seale); Cebu.

Gobius puntangoides Bleeker, Nat. Tijd. Ned. Ind., v, 1853, 242.

This East Indian species, not seen by us, resembles an *Awaous*, although figured as having the cheeks fully scaled.

AMBLYGOBIUS Bleeker.

Amblygobius Bleeker, Arch. Neerl. 1875, 322 (*sphinx*).
Odontogobius Bleeker, Arch. Neerl. 1875, 323 (*bynoensis*).

This genus is distinguished by the small scales, the robust form, and the presence of strong canines in the lower jaw. The species, like most of those of the related genus, *Pterogobius*, are cross-banded. We can see no generic differences separating *Odontogobius* from *Amblygobius*.

1471. **Amblygobius semicinctus** (Kner). Fiji; Oualan.

Gobius semicinctus, Kner, Sitz. Ak. Wiss. Wien, 31, **Oualan, Fiji.**

1472. **Amblygobius phalæna** (Cuvier & Valenciennes). Vanicolo; Samoa; Palau Is.; Tonga; Faté (Seale).

Gobius phalæna, Cuvier & Valenciennes, Hist. Nat. Poiss., XII, 92, 1837, **Vanicolo.** Gunther, Fische der Südsee, 178, taf. 111, Palau, Samoa, Tonga.

This handsome species is rather common on the soft bottom behind the coral reefs of Apia. It is closely related to *Amblygobius bynoensis*, the genus being characterized by the presence of rather strong canines on the side of the jaw. Scales small, covering top of head, and extending on opercle above; pectorals with no silk-like rays; dorsal vi, 15; anal 14.

Life colors of a specimen from Apia, dark olive; 5 dark brown bands, each edged on both sides with light blue, the bands broader than the grayer interspaces; from middle of each brown band a narrower bar crosses the back; head with many oblong and round sky-blue spots darker than the interspaces; 2 rows of orange spots on each side of nape; a round black shoulder spot; some bluish oblong dashes on front of side; first dorsal olive, with a black central blotch and a black edge; second dorsal mottled gray, then edged with light yellow, black and brown; caudal brownish, dusky behind; a black ocellus near base above; anal grayish with a row of whitish spots at base and a black edge; ventral black, paler centrally; pectoral bright golden yellow, with a blue horizontal streak and 2 blue spots at base. Body compressed, the scales rather small.

Another specimen, male, has 4 plain black cross-bars and 5 ocelli on caudal irregularly placed; the black margin broader, the dorsal with 2 rows of bluish dots, the anal with a bluish streak.

A third specimen from this locality was olive-green with round spots of grayish blue on head surrounded by dark blue streak; first dorsal olive with a black spot; second dorsal olivaceous mottled with dark brown; caudal light brownish with 2 black spots; a black spot above gill-opening; lower fins pale.

Seven specimens from Apia.

1473. Amblygobius papuanus (Peters). New Guinea.

Gobius papuanus Peters, Berl. Mon. 1876, 839, New Guinea.

1474. Amblygobius sphinx (Cuvier & Valenciennes). New Guinea; East Indies.

A very robust species with black cross-bands.

CRYPTOCENTRUS Ehrenberg.

Cryptocentrus (Ehrenberg) Bleeker, Arch. Neerl. 1875, 322 (*cryptocentrus*).

This genus, as understood by us, comprises species allied to *Rhinogobius* but covered with small scales, instead of large ones.

1475. Cryptocentrus leucostictus (Günther). Tonga.

Gobius leucostictus Günther, Proc. Zool. Soc. 1871, 664, Tonga. Gunther, Fische der Südsee, 176, Tonga.

This species, which we have not seen, seems to belong near *Cryptocentrus*.

VITRARIA Jordan & Evermann.

1476. Vitraria clarescens Jordan & Evermann. Hawaii.

PSELAPHIAS Jordan & Seale, new genus.

Pselaphias Jordan & Seale, new genus of Gobiidæ (*Gobius ophthalmonemus*).

This genus is close to *Gobionellus* (*hastatus*), and still closer to *Oxyurichthys* (*belosso*), differing from both in the presence of a tentacle above the eye.

1477. Pselaphias ophthalmonemus (Bleeker). Samoa; Fiji; Akyab; East Indies.

Gobius ophthalmonema Bleeker, Nat. Tijds. Ned. Ind. 1856, xii, 208.
Euctenogobius ophthalmonemus, Günther, Fische der Südsee, 180, taf. 111, fig. B, Tonga, Fiji, Akyab.

Life colors of an Apia specimen, a black bar below eye; dull olive with quadrate and other blotches along side; back mottled; no pale spots; no bright colors; fins much mottled; dorsal with a black blotch on last rays.

Three specimens from a sluggish bayou of Vaisigano River at Apia. Dorsal filamentous.

WAITEA Jordan & Seale, new genus.

Waitea Jordan & Seale, new genus of Gobiidæ (type *Gobius mystacina*).

This genus, of which *Gobius mystacina* is the type, is close to *Gobionellus*, but it has the maxillaries produced backward after the fashion of *Opisthognathus*. It is named for Mr. Edgar R. Waite, of Sydney, the excellent curator of fishes in the Australian Museum (now at the Museum of Christchurch, New Zealand).

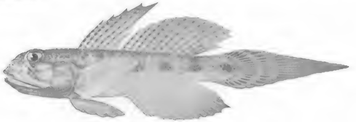


FIG. 91.—*Waitea mystacina* (Cuvier & Valenciennes).

1478. Waitea mystacina (Cuvier & Valenciennes). Samoa; Java.

Color nearly plain olive-green.

GOBIICHTHYS Klunzinger.

This genus has the elongate body and sharp caudal fin of *Gobionellus*, but the upper teeth are in one series.

1479. Gobiichthys lonchotus (Jenkins). Hawaii.

1480. Gobiichthys papuensis (Cuvier & Valenciennes). New Guinea; East Indies.

GOBIONELLUS Girard.

This genus contains elongate species with the caudal fin produced, the lower jaw flat, and the teeth small, in bands.

1481. Gobionellus atriclypeus (Garman). Fiji.

Gobius atriclypeus Garman, Bull. Mus. Comp. Zool., 1903, 233, XXXIX, with plate, Fiji.

This species, from Fiji, is unknown to us. From the slender form and acuminate caudal and the teeth in bands we refer it to *Gobionellus*.

GOBIOPTERUS Bleeker.

Gobiopterus Bleeker, Arch. Neerl. 1875, 311 (*brachypterus*).

This genus differs from *Apocryptes* in the large scales and short dorsal and anal.

1482. Gobiopterus farcimen Jordan & Evermann. Hawaii.

APOCRYPTODON Bleeker.

Scales about 50.

1483. Apocryptodon fasciatus (Macleay). New Guinea (Proc. Linn. Soc. N. S. W. 1884, 268).

PSEUDAPOCRYPTES Bleeker.

Pseudapocryptes Bleeker, Arch. Neerl. 1875, 327 (*lanceolatus*).

This genus is said to differ from *Apocryptes* (*bato*) in the tumid teeth and the minute scales.

1484. Pseudapocryptes lanceolatus (Bloch & Schneider). Tahiti (Kner, Novara Fische, 180); East Indies.

1485. Pseudapocryptes punctularum (De Vis). South Seas (probably Banks Group).

Gobiosoma punctularum De Vis, Proc. Linn. Soc. N. S. W. 1884, 449.

This species, and the closely allied *Gobiosoma guttulatum* Macleay from Australia, said to be scaleless, must be based on specimens of *Pseudapocryptes*, in which the minute scales have been overlooked. They have no affinity with *Gobiosoma*.

MARS Jordan & Seale, new genus.

Mars Jordan & Seale, new genus of Gobiidæ (*strigilliceps*).

This genus, typified by *Mars strigilliceps*, has the appearance of an ordinary goby with small scales, as in *Cryptocentrus*, which it much resembles. On the vomer, however, are 2 or 3 large blunt teeth, and the head is provided with minute filaments and pores arranged in straight lines and running in various directions, somewhat as in *Quisquilius* and in *Drombus*. The canals on the planet Mars perhaps justify the name of this genus.

1486. Mars strigilliceps Jordan & Seale, new species. Samoa.

Head 3.2 in length; depth 5; eye 4 in head; snout 5 in head; dorsal VI, 11; anal I, 9; scales 65, counting from posterior margin of opercle.

Body elongate, compressed, the anterior profile rounded; jaws equal; mouth rather large, the angle below middle of eye; several rows of small, sharp-pointed teeth in jaws; rather large blunt teeth on palatines and vomer, no teeth on tongue; opercle and preopercle entire; head without scales; a number of fine distinct raised chain-like lines radiating from eye and extending over or across the cheek; one across the nuchal region, joined by 3 or 4 other similar lines which run longitudinally on nuchal region; these probably serve as a mucus system; caudal peduncle 2.75 in head; second spine of soft dorsal elongate, filiform, about equal to length of head; base of soft dorsal 1.25 in head, its longest ray 1.75 in head; anal similar to soft dorsal, but with base and the anterior rays slightly shorter; pectorals 1.1 in head, the tips under origin of soft dorsal; ventrals united, rather elongate, 1.25 in head, a distinct shallow membranous cup at base, the membrane entire; caudal rounded, about 1.25 in head.

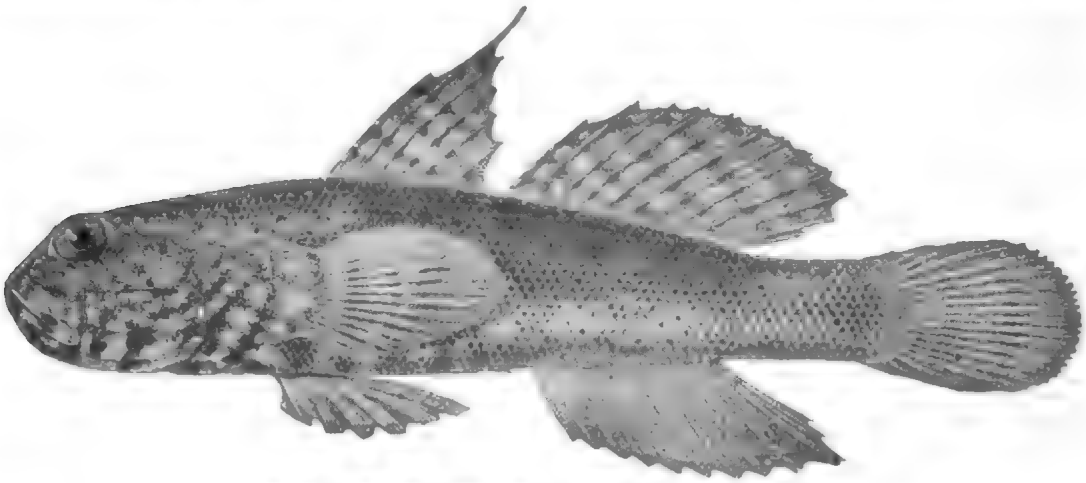


FIG. 95.—*Mars strigilliceps* Jordan & Seale, new species. Type.

Life colors, dark olive with 4 narrow grayish cross-bands, rather obscure; front of head dusky; lower part of head bronze-olive, with 6 sharply defined irregular white cross-bands; similar fainter cross-bands on belly; the white bar from front of spinous dorsal crossing base of pectoral and forming a ring about body; base of pectorals with white marblings; fins dusky olive with no clear markings; scales small; head with numerous lines of small pores each with a minute filament.

Color in spirits gray, with slight bluish wash; about 4 indistinct dusky blotches along side, the blotch on side of caudal peduncle being most distinct; 5 distinct bands of black alternating with bluish white surrounding the under part of head and throat, the posterior band white and extending from upper posterior margin of opercle around thorax at base of ventrals; about 5 light-blue bands around belly; 3 indistinct lighter lines over the back, 2 on nuchal region and 1 extending obliquely down from base of spinous dorsal; dorsal fins grayish with about 5 oblique dusky lines; 2 or 3 indistinct dusky bands on caudal; pectoral with 3 or 4 very indistinct dusky cross-bands, the base of the fin bluish with 2 or 3 dusky blotches; anal and ventral dusky without distinct marking.

One specimen from Apia. Type no. 51778, U. S. National Museum, length 2 inches.

KELLOGGELLA Jordan & Seale, new genus.

Kelloggella Jordan & Seale, new genus of Gobiidæ (*cardinalis*).

Brilliantly colored little fishes, allied to *Gobiosoma*, the body naked, but with only 6 dorsal spines, the body and head more elongate. Coral reefs of Samoa. The genus, typified by *Kelloggella cardinalis*, is named for its discoverer, Vernon Lyman Kellogg, professor of entomology in Stanford University.

1487. Kelloggella cardinalis Jordan & Seale, new species. Samoa. (Pl. LIII, fig. 1.)

Head 4.5 in length; depth 6; eye 4 in head; dorsal VI, 13; anal 9; no scales; interorbital one-half of eye; snout 4.

Body elongate, compressed; anterior profile rounded; the lower jaw a little the shorter, the angle under middle of eye; small sharp teeth in jaws, none on vomer or palatines; opercle and preopercle entire; width of gill-opening 2.1 in head; caudal peduncle strong, its depth 1.5 in head; origin of spinous dorsal posterior to a line with base of ventral; base of spinous dorsal 1.15 in head, its longest spine 2 in head; base of soft dorsal 2.8 in length of fish without caudal, its longest ray 2 in head; pectoral slightly longer than head, it's tip on line with sixth dorsal spine; ventrals small, 1.2 in head, their origin below axil of pectorals, their tips on line with base of fifth dorsal spine; the 2 fins fully united; caudal rounded, equal to head.

Life colors of the type specimen clear grass green, rather pale; both dorsals, caudal, and anal bright cherry-red; anal greenish in front; pectoral and ventral green. Two larger specimens were greenish black, more greenish anteriorly; dorsal and anal bright orange edged with black; pectoral and ventral bright golden green; caudal gray.

Color in spirits, a uniform dull green, a little less shaded on head and belly; fins all yellowish white; some specimens with a dusky margin to dorsals, caudal, and anal; the dorsals are also darker at base

Three specimens from Pago Pago. The type is no. 51785, U. S. National Museum, length 1.12 inches.

1488. Kelloggella oligolepis (Jenkins). Hawaii.

This species bears little resemblance to the genus *Enypnias* to which it has been referred. It may be provisionally placed in *Kelloggella*, from which it differs in form and in the presence of a few scales on the posterior part of the body.

GOBIODON Kuhl & Van Hasselt.

Gobiodon Kuhl & Van Hasselt, Bleeker, Boroe, 407, 1851 (*histrio*).

Small, deep-bodied gobies, entirely scaleless; jaws with canine teeth.

1489. Gobiodon histrio (Kuhl & Van Hasselt). Tonga; East Indies.

1490. Gobiodon rivulatus Rüppell. Tahiti; Guam; Tonga; Bonham I.; Vavau; Solomon Is.; Meduro; New Britain (Peters, Berl. Mon. 1876, 840); East Indies.

1491. Gobiodon ceramensis Bleeker. Fiji; East Indies.

Gobiodon ceramensis, Günther, Fische der Südsee, 180, Fiji.

1492. Gobiodon atrangulatus Garman. Fiji.

Gobiodon atrangulatus Garman, Bull. Mus. Comp. Zool. XXXIX, 1903, 235, Fiji.

1493. Gobiodon flavidus De Vis. Banks Group, east of New Guinea.

Gobiodon flavidus De Vis, Proc. Linn. Soc. N. S. W. 1884, 449.

1494. Gobiodon axillaris De Vis. Banks Group, east of New Guinea.

1495. Gobiodon lineatus De Vis. Banks Group, east of New Guinea.

1496. Gobiodon inornatus De Vis. Banks Group, east of New Guinea.

PSEUDOGOBIODON Bleeker.

Pseudogobiodon Bleeker, Arch. Neerl. 1875, 309 (*citrinus*).

No canine teeth, otherwise like *Gobiodon.*

1497. Pseudogobiodon citrinus (Rüppell). *Ulitui* (big-head). Samoa; Ponape (Günther); East Indies.

This species is very abundant in the coral reefs at Apia, where we obtained 32 specimens. The ground color varies from yellow to brown, but the blue vertical stripes are very constant.

One specimen in life from Apia, yellow-olive; fins all orange, the edges deep orange, the first dorsal edged with black; iris orange. Another was brown, tinged with orange; a blue line down from eye; a black opercular spot with a vertical blue line before and behind it; orange deepest under eye and on edge of pectoral. Other specimens were blackish olive; fins all broadly edged with blackish orange; no black edge on dorsal; a black spot on end of opercle.

1498. Pseudogobiodon verticalis (Macleay). New Guinea.

Gobiodon verticalis Macleay, Proc. Linn. Soc. N. S. W. 1884, 333.

SICYOPTERUS Gill.

Sicyopterus Gill, Proc. Ac. Nat. Sci. Phila. 1860, 101 (*stimpsoni*).

Lower jaw with 2 canines in front, snout tumid, projecting over the small mouth; body with small scales.

1499. Sicyopterus stimpsoni Gill. Streams of Hawaii.

Sicyopterus stimpsoni Gill, Proc. Ac. Nat. Sci. Phila. 1860, 101, streams of Hawaii.
Sicydium nigrescens Günther, Shore Fishes Challenger, 60, 1880, streams about Hilo.

1500. Sicyopterus tæniurus (Günther). Fiji; Aneiteum; Samoa; in streams.

Sicydium lagocephalus Kner, Sitz. Ak. Wiss. Wien 1868, 35, Viti Levu (Fiji), Namusi stream; not of Cuvier & Valenciennes.
Sicydinus macrostetholepis Kner, op. cit., 35, Samoa; not of Bleeker.
Sicydium tæniurum Günther, Fische der Südsee, 183, Viti Levu, Aneiteum, New Hebrides. Ogilvie-Grant, Proc. Zool. Soc. London 1884, 161, Aneiteum, Viti Levu.

Life colors of a specimen from Pago Pago, dark olive; 7 or 8 diffuse spots along side; a trace of lateral stripe along head; a black bar below eye; caudal pale olive with 3 black lengthwise stripes, the upper and lower oblique; dorsals plain dusky olive; pectoral plain olive; scales small; first dorsal pointed; ventral very small; head depressed; mouth inferior; teeth large; body low.

Two specimens agreeing very well with Günther's figure were taken in the stream at Pago Pago.

1501. Sicyopterus albotæniatus (Günther).

Sicyopterus albotæniatus Günther, Fische der Südsee, 184, Hawaii.

This fish is known only from the drawing of Mr. Andrew Garrett, made at Hilo, and published by Dr. Günther.

1502. Sicyopterus pugnans (Ogilvie-Grant). Samoa (Grant).

Sicydium pugnans Ogilvie-Grant, Proc. Zool. Soc. London 1884, 160, pl. XI, Savaii.

This species, from the rivers of the island of Savaii, was not seen by us.

1503. Sicyopterus tauæ Jordan & Seale, new species. Samoa.

Head 4.5 in length; depth 6.75; eye 4 in head; dorsal VI, 13; anal 11; scales about 62; snout 3.5; interorbital 3 in head.

Body elongate, compressed; the snout somewhat projecting, overhanging the small mouth; minute teeth in jaws and on vomer and palatines; depth of caudal peduncle 2 in head; origin of spinous dorsal posterior to line with distal end of ventrals, its longest spine 1.5 in head; base of soft dorsal 3.45 in length without caudal, its longest ray about 1.35 in head; anal similar to soft dorsal, its longest ray about 1.5 in head; origin of anal distinctly below origin of soft dorsal, being about equally distant between tip of snout and base of caudal fin; pectoral, 1.1 in head; ventral disk 2 in head, the anterior membranous margin of the cup entire; caudal almost square, its length 1.1 in head.

Color in spirits, yellowish with 7 rather broad bands of brownish over the back and down on side to a little below median line, the posterior one being at base of caudal and forming a complete dusky ring around caudal base; a row of about 10 small dark spots along base of soft dorsal; a dusky line at base of anal; sides and top of head somewhat shaded with minute dark dots; fins without distinct markings, a dark spot between eye and angle of mouth.

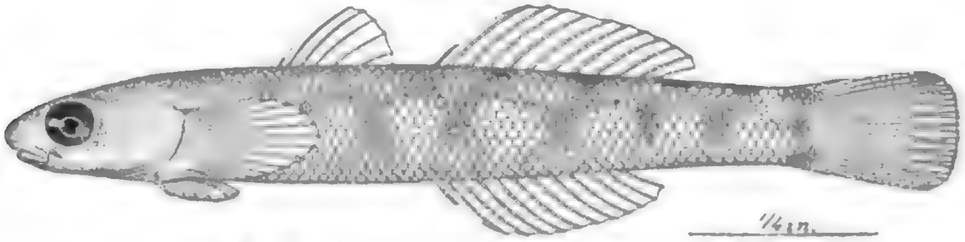


FIG. 96.—*Sicyopterus taua* Jordan & Seale, new species. Type.

One specimen, type no. 51786, U. S. National Museum, from Vaisigano River, Apia; length 1.35 inches. It is named for Taua, a Rarotonga man, the most skillful of the fishermen of Apia.

MICROSICYDIUM Bleeker.

Microsicydium Bleeker, Arch. Neerl. 1875, 315 (*gymnauchen*).

This genus may be provisionally distinguished from *Sicyopterus* by the large scales, 30 to 40.

1504. **Microsicydium elegans** (Steindachner). Tonga.

Sicydium elegans Steindachner, Sitz. Ak. Wiss. Wien 1879, 152, Tonga.

This strikingly colored species is well distinguished by its large scales (32). It was not taken by us.

LENTIPES Günther.

Body naked, or nearly so.

1505. **Lentipes concolor** (Gill). Rivers of Hilo, Hawaii.

1506. **Lentipes seminudus** Günther. Rivers of Hilo, Hawaii.

This species, which we have not seen, may be the type of a distinct genus.

GOBIOIDES Lacépède.

1507. **Gobioides totoyensis** Garman. Fiji.

Gobioides totoyensis Garman, Bull. Mus. Comp. Zool., vol. XXXIX, no. 8, 1901, 235, Totoya (Fiji Is.).

Family ECHENEIDIDÆ

PHTHEIRICHTHYS Gill.

1508. **Phtheirichthys lineatus** (Menzies). Pacific Ocean (Günther, Fische der Südsee, 156); tropical Atlantic (as a parasite on barracudas).

LEPTECHENEIS Gill.

1509. **Leptecheneis naucrates** (Linnæus). *Talitaliuli*. Samoa; Hawaii; New Guinea; warm seas generally.

One very large specimen of this common fish was taken at Apia. Dorsal XXIV, 37.
Life color, all dark brown; lateral band obscure.

ECHENEIS (Artedi) Linnæus. (*Remora* Gill.)

1510. **Echeneis remora** Linnæus. Hawaii; warm seas generally.

REMORINA Jordan & Evermann.

1511. Remorina albescens (Schlegel). Marcus I. (Bryan & Herre, Bishop Museum, 1903); New Guinea; China and Japan; America.

REMOROPSIS Gill.

1512. Remoropsis brachyptera (Lowe). Pacific Ocean; warm seas; Japan.

Family PLEURONECTIDÆ.

PLATOPHRYS Swainson. *Ali.*

1513. Platophrys mancus (Broussonet). *Ali.* Samoa; Johnston I.; New Guinea; Bougainville Is.; Rarotonga; Tahiti; Makatea; Tubuai and Faté (Seale); East Indies.

Pleuronectes mancus Broussonet, Ich. Decas., 1782, with plate, Tahiti; not *mancus* of Risso or Günther = *Platophrys podas*.

Rhombus macropterus Quoy & Gaimard, Voy. Uranie, 236, 1824, Rawak (New Guinea), on a rough drawing.

Rhombus paro Bleeker, Kokos, III, 177, Kokos.

Rhomboidichthys paro, Günther, Cat., IV 435, East Indies. Peters, Berl. Mon. 1876, 844, Bougainville Is.

This species is common on the sandy shores of Samoa, where it reaches a considerable size. It may be readily distinguished from *Platophrys pantherinus* by the larger number of anal rays (about 80), by the more varied coloration, by the form of the arch of the lateral line, and by other characters. It has been found at Johnston Island, but has not yet been recorded from Hawaii. We have 6 specimens, large and small, from Apia and Pago Pago.

Life colors of a specimen from Apia, yellowish gray; spots bluish gray with rim of darker gray; those on fins grayish white and grayish orange; 2 dark spots on lateral line.

1514. Platophrys pantherinus (Rüppell). *Ali.* Hawaii; Samoa; Marquesas Is.; East Indies.

Passer marchionessarum Valenciennes, Voy. Venus, Poiss., 344, pl. 9, Marquesas Is.

This species is very common about Hawaii. It is not rare about Samoa, where it is confounded with *Platophrys mancus* by the natives under the name of *ali*. We have 4 specimens from Apia. It is easily distinguished on comparison of specimens, the constantly smaller number of anal rays being diagnostic.

1515. Platophrys chlorospilus Gilbert. Deep seas of Hawaii.

1516. Platophrys inermis Gilbert. Deep seas of Hawaii.

SCÆOPS Jordan & Starks.

1517. Scæops spilura (Günther). New Guinea.

Rhomboidichthys spilurus Günther, Challenger Fishes, 1880, 47.

1518. Scæops xenandrus Gilbert. Deep seas of Hawaii.

ENGYPROSOPON Günther.

1519. Engyprosopon arenicola Jordan & Evermann. Hawaii.

1520. Engyprosopon hawaiiensis Jordan & Evermann. Hawaii.

PSEUDORHOMBUS Bleeker. (*Rhombiscus* Jordan & Snyder.)

1521. Pseudorhombus triocellatus (Bloch & Schneider). Tahiti (Kner, Novara Fische, 1867, 284); East Indies.

This East Indian species is once recorded from Tahiti. We doubt the accuracy of the record.

1522. Pseudorhombus guttulatus Macleay. New Guinea.

Pseudorhombus guttulatus Macleay, Proc. Linn. Soc. N. S. W. 1884, 276.

1523. Pseudorhombus ocellatus Günther. Admiralty Is.

Pseudorhombus ocellatus Günther, Challenger Fishes, 1880, 46.

PŒCILOPSETTA Günther.

1524. **Pœcilopsetta hawaiiensis** Gilbert. Deep seas of Hawaii.

TÆNIOPSETTA Gilbert.

1525. **Tæniopsetta radula** Gilbert. Deep seas of Hawaii.

ANTICITHARUS Günther.

1526. **Anticitharus debilis** Gilbert. Deep seas of Hawaii.

SAMARISCUS Gilbert.

1527. **Samariscus corallinus** Gilbert. Hawaii.

CHASCANOPSETTA Gilbert.

1528. **Chascanopsetta prorigera** Gilbert. Deep seas of Hawaii.

NEMATOPS Günther.

1529. **Nematops microstoma** Günther. Admiralty Is.

Nematops microstoma Günther, Challenger Fishes, 1880, 57.

PELECANICHTHYS Gilbert & Cramer.

1530. **Pelecanichthys crumenalis** Gilbert & Cramer. Deep seas of Hawaii.

Family SOLEIDÆ.

SOLEICHTHYS Bleeker.

1531. **Soleichthys heterorhinos** (Bleeker). Fiji (Günther); Samoa (Kner); East Indies.

MICROBUGLOSSUS Günther.

1532. **Microbuglossus nigrostriolatus** (Kner & Steindachner). Fiji.

Solea nigrostriolata Kner & Steindachner, Sitz. Ak. Wiss. Wien 1870, 427, **Viti Levu (Fiji).**

ASERAGGODES Bleeker.

1533. **Aseraggodes melanostictus** (Peters). Bougainville Is.

Achirus melanostictus Peters, Berl. Mon. 1876, 845. **Bougainville Is.**

1534. **Aseraggodes pellucidus** (Bennett). Open Pacific.

Achirus pellucidus Bennett, Whaling Voyage, 277, 1840, **Pacific, open sea.**

This larval sole has not been recognized since the original description. We do not know to what genus it belongs.

PARDACHIRUS Günther.

1535. **Pardachirus pavoninus** (Lacépède). Faté; New Hebrides (Seale); East Indies.

ZEBRIAS Jordan & Snyder.

1536. **Zebrias dicholepis** (Peters). New Hanover; Bismarck Is.

Synaptura dicholepis Peters, Berl. Mon. 1875, 844, **New Hanover (Bismarck Is.).**

SYMPHURUS Rafinesque.

1537. **Symphurus undatus** Gilbert. Deep seas of Hawaii.

1538. **Symphurus strictus** Gilbert. Deep seas of Hawaii.

Family URANOSCOPIDÆ.

URANOSCOPUS Cuvier.

1539. **Uranoscopus sulphureus** Cuvier & Valenciennes. Tonga.

Uranoscopus sulphureus Cuvier & Valenciennes, Hist. Nat. Poiss., VIII, 495, 1831, **Tonga.** Günther, Cat., II, 229. Tonga.

1540. Uranoscopus fuscomaculatus Kner. Kandavu in Fiji.

Uranoscopus fuscomaculatus Kner, Sitz. Ak. Wiss. Wien 1868, 319, Kandavu (Fiji).

1541. Uranoscopus papuensis Bleeker. Waigiu.

Family CHAMPSODONTIDÆ.

CHAMPSODON Günther.

1542. Champsodon vorax Günther. Admiralty Is.; Japan.

1543. Champsodon fimbriatus Gilbert. Hawaii.

Family PERCOPHIDIDÆ.

MACRIAS Gill & Townsend.

1544. Macrias amissus Gill & Townsend. Deep seas of the Southern Pacific.

Macrias amissus Gill & Townsend, Science, 1901, 937, Pacific, deep sea.

Known from the type only. Said to be the largest bathybial fish known.

Family PTEROPSARIDÆ.

PARAPERCIS Bleeker.

1545. Parapercis tetracanthus (Lacépède). *Ta'oto.* Samoa; Fiji; Guam; Palau Is.; East Indies.

Percis tetracanthus Bleeker, Nat. Tijds. Ned. Ind. 1853, 458. Günther, Cat., II, 241, Fiji, Amboina. Günther, Fische der Südsee, 158, taf. XCIII, fig. B, Pelew, Samoa, Fiji.
Parapercis tetracanthus Garman, Bull. Mus. Comp. Zool., XXXIX, no. 8, 233, Fiji.
Parapercis cephalopunctatus Seale, Bishop Museum 1901, 124, Guam.

Of this interesting species, half a dozen specimens were obtained in the reefs of Apia.

Life colors of one specimen: The dark markings bright olive brown, the belly white, the upper parts light olive; no red; a large pure white spot on caudal with black before it.

1546. Parapercis hexophthalma (Ehrenberg). Fiji (Günther); Louisiades; East Indies.

1547. Parapercis xanthozoma (Bleeker). Shortland I.; Solomon Group (Seale); East Indies.

1548. Parapercis alboguttata (Günther). Misol.

Percis alboguttatus Günther, Ann. Mag. Nat. Hist. 1872, 422, Misol.

OSURUS Jordan & Evermann.

1549. Osurus schauinslandi (Steindachner). Samoa.

Parapercis pterostigma Jenkins, Bull. U. S. Fish Comm., XIX, 1899 (1901), 402, fig. 15, Honolulu.

NEOPERCIS Steindachner.

1550. Neopercis roseoviridis Gilbert. Hawaii.

BEMBROPS Steindachner.

1551. Bembrops filifera Gilbert. Hawaii.

CHRIONEMA Gilbert.

1552. Chrionema chryseres Gilbert. Hawaii.

1553. Chrionema squamiceps Gilbert. Hawaii.

OSOPSARON Jordan & Starks.

1554. Osopsaron incisum Gilbert. Hawaii.

Family HARPAGIFERIDÆ.

DRACONETTA Jordan & Fowler.

1555. **Draconetta hawaiiensis** Gilbert. Deep seas of Hawaii.

Family RHYACICHTHYIDÆ.

RHYACICHTHYS Boulenger.

Platyptera Cuvier & Valenciennes, Hist. Nat. Poiss., XII, 321, 1835 (*aspro*); name preoccupied.
Rhyacichthys Boulenger, Ann. Mag. Nat. Hist. 1903 (*aspro*).

1556. **Rhyacichthys aspro** (Kuhl & Van Hasselt). Swift rivers in the Solomon Is. (Günther, Fische der Sudsee, 191); East Indies.

Family CALLIONYMIDÆ.

CALLIURICHTHYS Jordan & Snyder.

1557. **Calliurichthys simplicornis** (Cuvier & Valenciennes). Guam.

1558. **Calliurichthys decoratus** Gilbert. Hawaii.

1559. **Calliurichthys japonicus** (Houttuyn). New Guinea (Günther); Japan.

CALLIONYMUS Linnæus.

1560. **Callionymus cooki** Günther. Rarotonga.

Callionymus cooki Günther, Proc. Zool. Soc. 1871, 605, **Rarotonga.** Günther, Fische der Südsee, 192, taf. 113, fig. a, Rarotonga.

1561. **Callionymus calauropomus** Richardson. New Ireland (Peters, Berl. Mon. 1876, 841); Australia.

1562. **Callionymus cæruleonotatus** Gilbert. Hawaii.

1563. **Callionymus rubrovinctus** Gilbert. Hawaii.

1564. **Callionymus corallinus** Gilbert. Hawaii.

SYNCHIROPUS Gill.

1565. **Synchiropus microps** (Günther). Tonga.

1566. **Synchiropus lineolatus** (Cuvier & Valenciennes). Bougainville I. (Peters, Berl. Mon. 1876, 841); East Indies.

1567. **Synchiropus lili** Jordan & Seale. *Lili.* Samoa. (Pl. LIII, fig. 2.)

Head 3 in length; depth 5; eye 3.5 in head; dorsal IV–8; anal 7; lateral line complete, running near base of dorsal fins; interorbital equal to pupil; snout 4 in head.

Body elongate, widest at base of pectoral, compressed posteriorly; the anterior profile rounded to the mouth; lower jaw slightly the longer; angle of mouth under anterior margin of eye; mouth small, protractile, with minute teeth in jaws; caudal peduncle 3.75 in head; preopercular spine very strong with 2 strong curved claws, one of which is directed inward; origin of dorsal fin directly above posterior margin of opercle, its longest spine 2 in head; base of soft dorsal 1.1 in head; pectoral 1.3 in head, its tip under third ray of dorsal; base of the large ventrals entirely anterior to base of pectorals, the anterior margin of the base being anterior to preopercular spine; base of anal 1.1 in head, its origin an equal distance from tip of snout and base of caudal fin; caudal rounded, 1.1 in head.

Color in spirits dark brown with tint of green, white below; 3 rather wide irregular bands of white over the back, the first of these at posterior end of spinous dorsal and at origin of soft dorsal, this band separated above by a small brown band, but the whole area joining into one band on the lateral line; second white band at middle of soft dorsal, third over caudal peduncle, the 3 joined by irregular blotches of whitish; 3 round white spots below median line of body, and a few scattered small white dots over body; small blue dots over cheeks, 3 dark bands on underpart of head alternating with white bands; spinous dorsal brown, the base black, with 4 distinct black ocelli on upper half of fin, posterior to which are 4 vertical blue lines; soft dorsal with about 4 irregular oblique dusky bands; caudal with a broad black band near middle, and a half band on upper posterior part; anal dusky, with narrow white tip, a broad black intramarginal area and some narrow oblique blue lines; pectoral clear yellow; ventral blackish with white band near middle, and a white margin.

Life colors, black mottled with dark gray; pectoral yellow, edged broadly with golden.

Two specimens from Apia. Type no. 51762, U. S. National Museum, length 1.35 inches.

Family BATRACHOIDIDÆ.

OPSANUS Rafinesque.

1568. **Opsanus dubius** (White). New Guinea (Macleay); Australia.

MARCGRAVIA Jordan.

1569. **Marcgravia grunniens** Linnæus. New Guinea (Macleay); East Indies.

1570. **Marcgravia diemensis** (Richardson). New Guinea (Günther, Challenger Rept. 1880, 39); Australia.

Family BLENNIIDÆ.

ENNEAPTERYGIUS Rüppell. (*Enneanectes* Jordan; *Gillias* Evermann & Marsh.)

This genus as understood by us includes most of the Pacific species referred to *Tripterygion*. It differs from *Tripterygion* as typified by the Mediterranean species, *T. tripterygion*, in the shorter jaws, the presence of a cirrus above the orbit, and in the larger scales. The lateral line is always incomplete. The species found in coral heads in Samoa are all minute, similar in size and habit to the species of *Eriota*, but those found on the coast of Japan are much larger.

1571. **Enneapterygius minutus** (Günther). Samoa.

Tripterygium minutum Günther, Fische der Südsee, 211, taf. 118, fig. D, 1876, **Apia**.

Described from a specimen an inch long taken at Apia, from which place we have a similar example. Apparently the fin rays were wrongly counted by Günther, as ours has the dorsal rays III–XI, 10.

1572. **Enneapterygius atriceps** (Jenkins). Hawaii.

1573. **Enneapterygius hemimelas** (Kner & Steindachner). Samoa.

Tripterygium hemimelas Kner & Steindachner, Sitz. Ak. Wiss. Wien, LIV, 1866, 372, **Samoa**. Günther, Fische der Südsee, 210, 1876, **Samoa**.

Life colors of a specimen from Apia, deep red mottled with dusky; posterior half of head blackish olive above and below; posterior half of trunk abruptly black, with 3 white rings; fins all cherry-red, the caudal abruptly pale red.

Another specimen from this locality had the middle third of body strongly rosy, also pectoral, ventral, and anal, and head in front of eyes; behind eyes and in front of pectoral greenish with yellow spots and rosy and black points; hinder third greenish yellow and brownish bands alternately; caudal clear with slight rosy tinge.

Five specimens from Apia and one from Pago Pago.

1574. **Enneapterygius tusitalæ** Jordan & Seale, new species. Samoa.

Head 3.30 in length; depth 5.20; eye 3.10 in head; dorsal III–XI–9; anal 17; scales 29, 9 in the lateral line. Another specimen had dorsal III–XI–8; anal 16.

Body elongate, compressed, largest at shoulder-girdle; snout pointed, the angle of mouth under the anterior margin of eye; minute teeth in jaws; middle of first dorsal fin over the posterior tip of opercle; base of second dorsal equal to head, its longest spine 2 in head; base of third dorsal 2 in head; base of anal 2.4 in length of fish without caudal, the origin nearer tip of snout than base of caudal; pectorals long, 2.75 in fish without caudal, the tips under the posterior third of second dorsal; ventrals 2.1 in head, situated anterior to base of pectorals; caudal rounded, 1.14 in head.

Color greenish in life, the fins dark. In spirits, owing to the thick dots of brown all over the body, this fish has a dusky appearance, but the ground color is really dull yellowish white; many of the brown dots, especially on the cheek, belly, and thorax are modified into distinct ocelli, the center being a black dot with the surrounding ring of brown; the cheek and a line to tip of snout are deep black; no dark bands on the body, but traces of about 5 indistinct whitish blotches; dorsal fins slightly shaded with 5 dark dots without lines; pectoral and caudal very dark, without bars or spots; anal also thickly dotted with fine black specks, but not so dark as caudal or pectoral; eye golden with one dark line through its length.

This species is very near *T. pardochir* and an examination of a series may prove them to be identical.

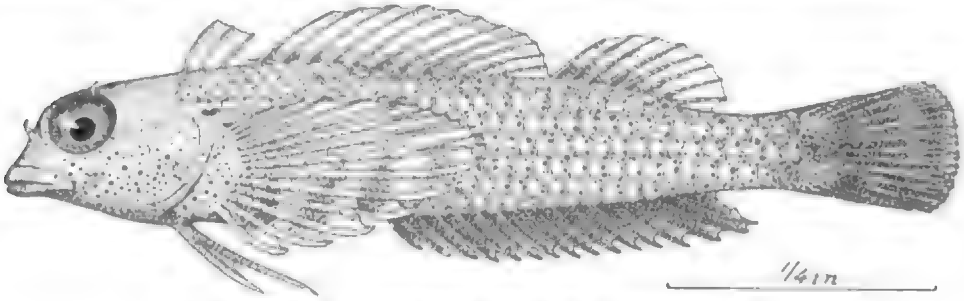


FIG. 97.—*Enneapterygius tusitalæ* Jordan & Seale, new species. Type.

We have about 10 specimens from the reef at Apia. Type no. 51800, U. S. National Museum, from Pago Pago, length 0.85 inch. Named for the "tusitala" (story-teller) of Samoa, Robert Louis Stevenson.

1575. Enneapterygius pardochir Jordan & Seale, new species. Samoa.

Head 3.5 in length; depth 4.14; eye 3.1 in head; snout 4.5 in head; interorbital narrow, one-half as wide as eye; dorsal III-XI-9; anal 18; scales 33; lateral line short, ending under posterior third of second dorsal.

Body elongate, compressed, scaled; depth of caudal peduncle 3 in head; the lower anterior profile of head slightly produced; angle of mouth under anterior third of eye; snout rather pointed and beak-like; minute teeth in jaws; a minute simple tentacle over eye and at nostril; middle of first dorsal over the posterior margin of opercles; base of second dorsal slightly greater than length of head, its longest spine 1.9 in head; 2 rows of scales between the second and third dorsal; base of third dorsal 1.4 in head, its longest ray 2 in head, its distal end some distance from the caudal; a very prominent anal papilla modified into an intromittent organ in males; anal fin rather long, its base 2.5 in length of fish, its origin under the base of the sixth spine of second dorsal and its distal end on a line with end of soft dorsal, the origin of the fin nearer tip of snout than base of caudal; pectoral equal to length of head, its tip under the ninth spine of second dorsal; ventral 1.5 in head, its origin anterior to base of pectoral; caudal rounded, 1.5 in head.

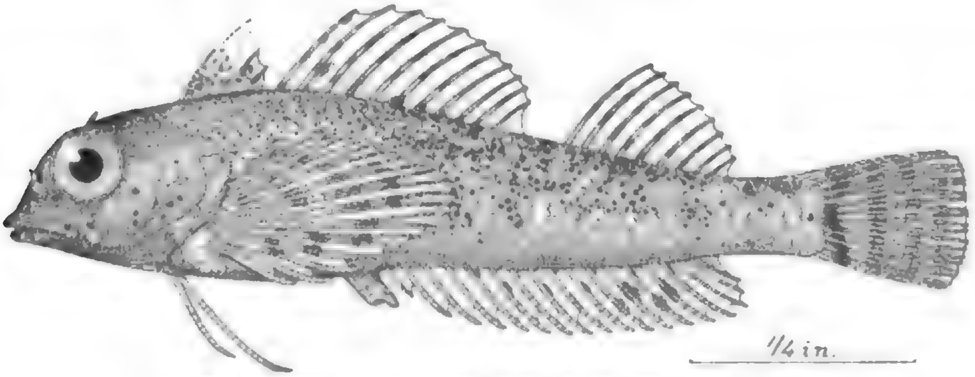


FIG. 98.—*Enneapterygius pardochir* Jordan & Seale, new species. Type.

Life colors of various specimens were as follows:

(1) From Apia. Cherry-red with darker bars, most distinct and paired along side; iris scarlet; fins all reddish, barred with brown; a black dot surrounded by pale at base of caudal.

(2) From Pago Pago. Rose-pink, with bands of dark brown-red, and of white; pectoral, dorsal, and caudal barred with dark red-brown.

(3) From Pago Pago. With marks showing through from inside; outside whitish with abundant black points; transverse blackish bar; pectoral barred.

(4) From Apia. Bright green, with bronze dots; sides with large white spots; 2 white dots at base of caudal; pectoral banded white and reddish brown; iris golden; upper fins pale and dotted; lower darker, the anal dark brown barred with white.

(5) Less green than the preceding, with traces of a brown lateral band.

Color in spirits, from yellowish white to light brown with shading of darker brown spots, which in young specimens show a tendency to form vertical irregular bands along sides, this showing only at base of dorsal in type; the distinctive markings found on all specimens are 4 dark bands across the pectoral, and 4 similar bands on the caudal, the 2 near the base the most distinct; dorsal fins also with 3 or 4 oblique dark band-like rows of blotches on their spines and rays; a few larger black spots on cheeks and opercles.

Of this well-marked species we have 15 specimens from Pago Pago and Apia. Type no. 51799, U. S. National Museum, from Apia, length 1.06 inches.

1576. Enneapterygius tutuilæ Jordan & Seale, new species. Samoa.

Head 3 in length; depth 4; eye 3.1 in head; dorsal III-XII-9; anal 18; scales about 33; lateral line ending under middle of second dorsal.

Body elongate, compressed, scaled; depth of caudal peduncle equal to eye; lower profile of head projecting, the large eyes forming a convexity in the profile, otherwise the profile somewhat rounded to the mouth, angle of mouth under middle of eye; snout rather pointed; minute teeth in jaws; a short simple tentacle over eye and at nostril; first dorsal fin rather high and distinct, its base in front of posterior margin of opercle; base of second dorsal about equal to head, its longest ray 2.5 in head; base of third dorsal 1.75 in head, its longest ray 2.25 in head; origin of anal under sixth spine of second dorsal, its base 2.5 in length of fish without caudal; its origin at equal distance between tip of snout and base of caudal; pectoral slightly greater than length of head; caudal rounded, 1.25 in head; ventral situated anterior of pectoral, its length 1.25 in head.

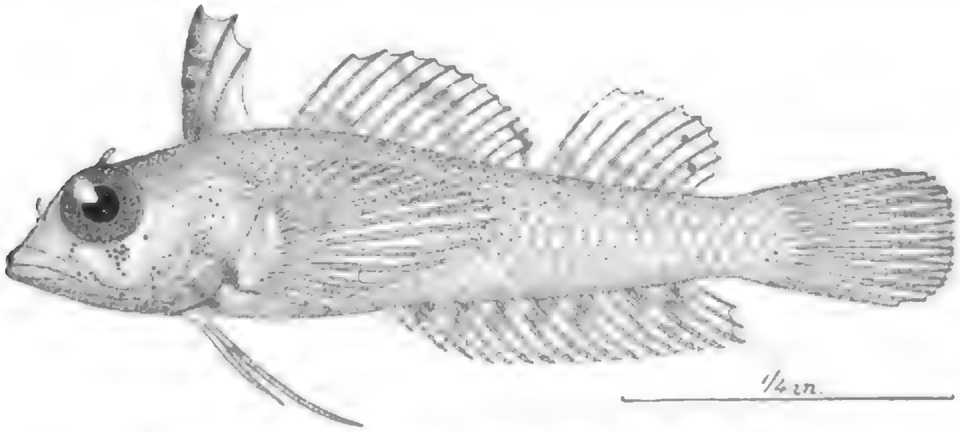


FIG. 99.—*Enneapterygius tutuilæ* Jordan & Seale, new species. Type.

Life colors of one specimen, greenish pinkish, with about 9 dark cross-bars, which become blackish bars across base of anal; a green bar between 2 white ones at base of caudal; fins barred with reddish brown; first and second dorsal blackish; head dotted and mottled with reddish.

Another specimen was translucent yellow white with many fine points, some rose-red, some black-brown, mixed all over body and fins; head darker; the fine spots weakly segregated into transverse bars, more distinct on belly.

Color in spirits, yellowish white, shaded with black spots tending slightly toward wide band-like arrangements on back; a heart-shaped dusky area on nuchal region; the most conspicuous marking is the 7 distinct vertical black bands of the anal fin; one dark band just in front of lower base of pectoral; a black spot in front of intromittent organ, 2 or more dark blotches below the eye; a dusky wash on anterior of first dorsal fin; second and third dorsals each with about 4 rather irregular oblique blotches of dusky; caudal without markings; pectoral with 4 dusky blotches, ventral with 2 dusky bars.

Four specimens from the reef at Pago Pago. The type is no. 51801, U. S. National Museum, length 0.75 inch.

1577. Enneapterygius cerasinus Jordan & Seale, new species. Samoa.

Head 3.5 in length; depth 4.5; eye 3 in head; dorsal iii–xii–9; anal 15; scales about 36; lateral line extending to below posterior part of second dorsal.

Body elongate, compressed, scaled; depth of caudal peduncle 3.15 in head; head pointed, the mouth small; minute teeth in jaws; angle of mouth under anterior margin of pupil; a minute orbital and nasal tentacle; middle of first dorsal fin not so high as second dorsal, its base 1.2 in height; base of second dorsal slightly longer than head, its longest ray 2 in head; a space of one and one-half rows of scales between second and third dorsal, base of third dorsal 1.45 in head, its longest ray 2 in head, its last ray two-thirds of eye; origin of anal under seventh spine of second dorsal, midway between tip of snout and tip of caudal, its base 2.3 in length of fish without caudal, its longest ray 2.5 in head; pectoral 1.14 in head; caudal slightly shorter; ventral 1.5 in head, the origin anterior to pectoral.

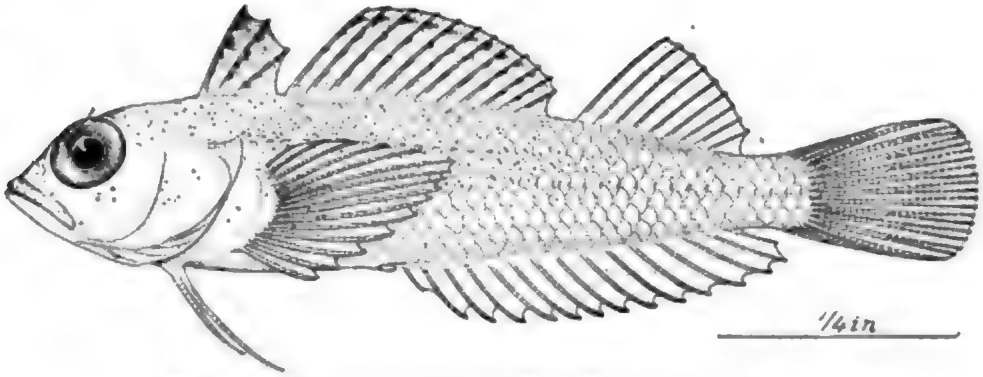


Fig. 100.—*Enneapterygius cerasinus* Jordan & Seale, new species. Type.

Life colors, clear reddish brown marbled with olive; 2 blackish brown dots at base of caudal; pectoral mostly plain scarlet; caudal pale orange; other fins feebly barred with brownish.

Color in spirits, yellowish white with a few scattered dark specks on upper half of body and head; 4 distinct black dots below eye; a few minute dots on snout and maxillary; anterior dorsal with 4 indistinct oblique bands of dusky; the second dorsal with an indistinct dusky submarginal band with indications of 3 other longitudinal dusky bands, these being seen only under a good lens; all the other fins uncolored.

One specimen, type no. 51802, U. S. National Museum, from Apia, length 1 inch.

1578. Enneapterygius hudsoni Jordan & Seale, new species. Samoa.

Head 3.2 in length; depth 4.5; eye 3 in head; dorsal iii–xiv–10; anal 20; scales about 40; lateral line extending to anterior third of last dorsal.

Body elongate, compressed, scaled, except head and a rather broad area on each side of first and second dorsal; apparently a well developed system of mucus canals about the head; depth of caudal peduncle equal to eye; anterior profile of head with the mouth slightly produced, forming an angle somewhat greater than 45°; mouth small, the angle being under the middle of eye; minute teeth in jaws; a small fringed tentacle at nostril; posterior margin of first dorsal over posterior margin of opercle, fin high, its base 1.95 in height; second dorsal extending to above the tenth anal ray; the base of last dorsal 1.5 in head, its longest ray 3 in head; origin of anal under base of seventh spine of second dorsal, its base 2.25 in length of fish without caudal, its origin nearer tip of snout than base of anal; pectoral slightly longer than head; ventral 1.75 in head; caudal rounded, about 1.5 in head.

Color in spirits, yellowish white with rather irregular brownish blotches, which are more regular along the middle of sides, forming round dusky spots with slight oblique upward projections, these dark spots alternate with distinct white spots; top of head shaded darker, a rather distinct black band from eye down sides of snout to near the tip; a number of fine black dots on opercle; an indication of about 5 dusky bands, alternating with bands of white dots over the back; anal fin with dusky spot at base; a rather prominent dusky spot on lower part of opercle; another just below eye; 3 dusky blotches on pectoral; a slight dusky wash on posterior margin of second dorsal; 2 indistinct oblique bands on last dorsal; first dorsal with scattered dark dots; caudal without markings.

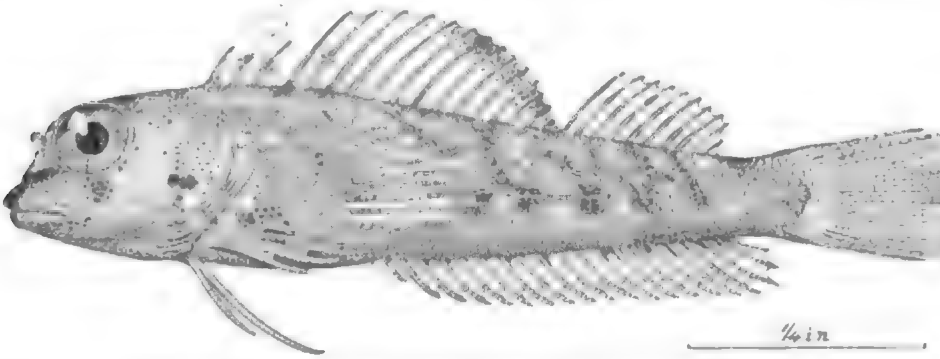


Fig. 101.—*Enneapterygius hudsoni* Jordan & Seale, new species. Type.

One specimen from Apia, type no. 51798, U. S. National Museum, length 1 inch. Named for Mr. R. L. Hudson, the artist.

CRISTICEPS Cuvier & Valenciennes.

1579. Cristiceps roseus Günther. New Guinea.

SAUVAGEA Jordan & Seale, new generic name.

Sauvagea Jordan & Seale, new generic name in Blenniidæ (*caledonica*).

Lepidoblennius Sauvage, Rev. Zool. 1874, 337 (*caledonicus*); not of Steindachner, 1867.

This genus, with 2 dorsals, the first of 8 spines, and the body scaly, is an ally of *Clinus*. The name *Lepidoblennius* is preoccupied. We may therefore give the genus a new name in honor of its discoverer, Dr. H. E. Sauvage, of Boulogne-sur-mer.

1580. Sauvagea caledonica (Sauvage). New Caledonia.

Lepidoblennius caledonicus Sauvage, Rev. Zool. 1874, 338, **New Caledonia.**

BLENNIUS Linnæus.

1581. Blennius sordidus Bennett. Hawaii.

Blennius sordidus Bennett, Zool. Journ., IV, 1829, 34, **Honolulu.** Cuvier & Valenciennes, Hist. Nat. Poiss., XI, 256, 1836, Honolulu. Günther, Fische der Südsee, 193, taf. 113, fig. D, Sandwich Is.

1582. Blennius canescens Garman. Fiji.

Blennius canescens Garman, Bull. Mus. Comp. Zool., vol. XXXIX, no. 8, 1903, Fiji.

1583. Blennius tonganus Jordan & Seale, new name. Tonga.

Blennius cristatus, Günther, Fische der Südsee, 194, taf. 113, fig. E, Tonga; not of Linnæus.

This species from Tonga, characterized by the long row of nuchal filaments, is unknown to us. Dr. Günther identifies it with *Blennius cristatus* Linnæus, a species of the West Indies, originally described from Ascension Island. It is not at all likely that this Pacific species is identical with *Blennius cristatus*, and we therefore propose for it the new name *B. tonganus*.

HYPLEUROCHILUS Gill.

This genus differs from *Blennius* in having the gill-openings restricted to the sides, the membranes not forming a free fold across the isthmus as in *Blennius*.

1584. Hypleurochilus vaillanti Jordan & Seale, new species. Samoa.

Head 3.75 in length; depth 4; eye 2.75 in head; dorsal XII, 15; anal 17; lateral line consisting of about 6 separated pores.

Body elongate, compressed; the anterior profile of head rounded, the mouth slightly produced beyond the forehead; angle of mouth under anterior margin of eye; mouth rather small with a single row of teeth in jaws and a pair of curved fang-like canines in under jaw; gill-openings rather narrow, 2.2 in head; dorsal fin not incised, extending to base of caudal, the membrane of the fin united to rays of the caudal; origin of anal under first dorsal ray, nearer tip of snout than base of caudal, its distal end extending to caudal fin, where its membrane is slightly united to caudal; longest anal ray 1.75 in head; pectoral 1.2 in head; ventral 1.3 in head, the origin anterior to origin of pectoral; caudal rounded, 1.5 in head.

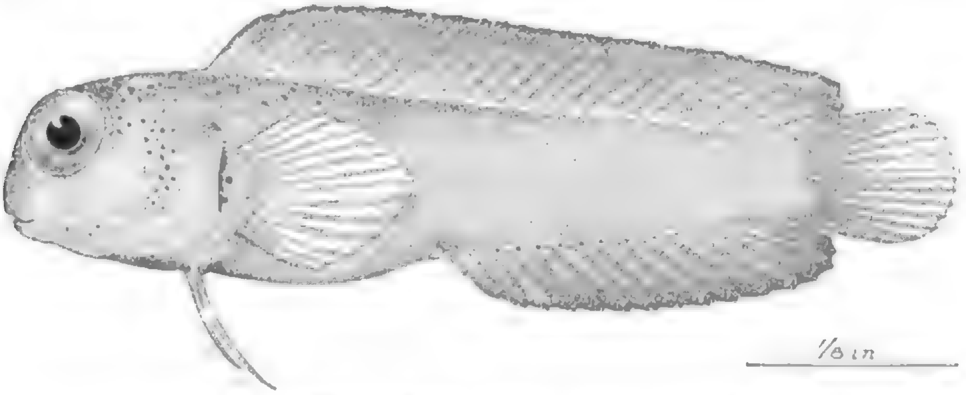


FIG. 102.—*Hypleurochilus vaillanti* Jordan & Seale, new species. Type.

Life colors, anterior part fuliginous; posterior third greenish with mottling of fine black points; top of head covered with small round black dots; 1 or 2 similar dots on base of pectoral; dorsal and anal plain brown, darker than body; caudal pale olive-green.

Color in spirits, yellowish white shaded everywhere with minute dusky dots like pin pricks, a few larger dots on top and sides of head; 2 distinct black dots on base of pectoral fins; fins colored like body, the dorsal and anal being a shade darker.

One specimen, length 0.56 inch, type no. 51788, U. S. National Museum, from Pago Pago, Samoa.

1585. **Hypleurochilus periophthalmoides** (Macleay). New Guinea.

Blennius periophthalmoides Macleay, Proc. Linn. Soc. N. S. W. 1883, 269. (Apparently a *Hypleurochilus;* teeth not described.)

ALTICUS (**Commerson**) **Lacépède.** *Mano'o.*

Alticus (Commerson MS.) Lacépède, Hist. Nat. Poiss., II, 458, 1800 (*saltatorius=saliens*).
Alticus Cuvier & Valenciennes, Hist. Nat. Poiss., XI, 337, 1836 (*alticus*).
Erpichthys Swainson, Class. Anim., II, 275, 1839 (*atlanticus*).
Rupiscartes Swainson, Class. Anim., II, 275, 1839 (*alticus*).
Entomacrodus Gill, Proc. Ac. Nat. Sci. Phila. 1859, 168 (*nigricans*).

This genus differs from *Salarias* in the presence of posterior canines in one or both jaws. In both genera the teeth are loosely inserted, and the gill-membranes form a broad fold, free from the isthmus.

The case of *Alticus*, quoted by Lacépède from manuscripts of Commerson, is parallel to that of *Zanclus* (vs. *Pomacanthus*), and of *Antennarius* (vs. *Histrio*), and in all these cases we allow precedence to the earlier name.

1586. **Alticus saliens** (Forster). Tanna; Samoa; New Britain; Vavau; Nukahiva (Seale). (Fig. 111, p. 439.)

Blennius saliens Forster, Itin., II, 343, 1788, **Tanna.**
Blennius saliens, Lacépède (*Alticus saltatorius* Commerson), **Hist. Nat. Poiss.**, II, 458, 1800, New Britain.
Blennius amphibius Walbaum, Artedi Pisc., III, 187, 1792, Tanna, after Forster.
Blennius tridactylus Bloch & Schneider, Syst. Ichth., 1801, 176; after *Blennius gobioides* Forster.
Salarias tridactylus, Günther, Fische der Südsee, 200, taf. 117, figs. C, D, Vavau.
Salarias alticus Cuvier & Valenciennes, Hist. Nat. Poiss., XI, 337, 1836.
Blennius gobioides Forster, Descript. Anim., 283, 1844. **Tanna.**

This wiry little blenny covers the lava rocks on the "iron-bound coast" of the Samoan Islands; leaping on the bare rocks in the sun like a lizard and leaping into the sea with the greatest velocity when disturbed. It is not found in the coral. At Apia it swarms in the wreck of the German warship *Adler*, but it could not be taken there by any means at our disposal.

We have 7 specimens from Pago Pago. Life colors of one of these, violet-black, with a few pale bluish spots along middle of side; dorsal pale-edged; body with about 9 pale, poorly defined, transverse double bars, which form a series of pale spots along middle of side; throat and belly pale, becoming yellowish posteriorly; anal pale in some specimens, the rays faintly spotted with black specks; in others this fin is colored like the dorsal, and nearly or quite as dark; caudal and pectoral black.

1587. Alticus periophthalmus (Cuvier & Valenciennes). Ticopia; Samoa; Santa Cruz; Rarotonga; Futuna; Tahiti; Mangareva; Nukahiva and Makatea (Seale); India.

Salarias periophthalmus Cuvier & Valenciennes, Hist. Nat. Poiss., XI, 311, pl. 328, 1836, **Ticopia.** Günther, Fische der Südsee, 207, taf. 114, figs. D, E, Santa Cruz, Samoa, Rarotonga, Futuna, Society Is., Savaii. Day, Fishes of India, 333, pl. 69, fig. 5, Andamans Is.

Salarias andamanensis Day, Proc. Zool. Soc. 1869, 611, **Andamans Is.**

Life colors of a specimen from Apia, body mottled gray-olive and purplish, the latter in paired bars, or inverted Y-shaped, about 8 in number; side with a few oblong spots of bright violet, arranged in 2 rows, about 5 in each row; an orange blotch behind eye, with a greenish violet bar behind it; a greenish violet dash below eye; cirri orange; dorsal much mottled brown, grayish and orange, the edge pale, with orange spots; caudal pale above, purplish black below, ending in blackish orange, the lower lobe darkest; anal mainly black, orange at base; pectoral pale, never sprinkled with black dots as in *Alticus evermanni*.

Another specimen was light olive; 9 quadrate spots or bars of dark brown along side, these alternating above with another series of irregular blotches; crest high, edged with dull red; second dorsal and upper part of caudal edged with creamy red, rather bright; cirri pink.

Other specimens have the margin of the spinous dorsal with dark spots; still others have the spinous dorsal plain and in some both dorsals are crossed by the dark bars on the body. In some specimens the characteristic blue spots on the sides are obsolete.

This species is abundant in the coral reefs at Samoa; we have 50 specimens from Apia and 4 from Pago Pago.

1588. Alticus evermanni Jordan & Seale, new species. Samoa.

Sararias nitidus Günther, Fische der Südsee, 200, taf. 113, fig. G, Samoa; not *Salarias nitidus* Günther, Cat., III, 243, **from China.** Seale, Bishop Museum 1901, 127, Guam.

Head 4.75 in length; depth 6; eye 4 in head; dorsal XII, 21; anal 25; lateral line short, ending under tenth dorsal spine; interorbital equal to one-half of eye; angle of mouth under posterior margin of eye, slightly posterior.

Body elongate, compressed, anterior profile slightly subvertical, the forehead projected beyond the jaws; a divided orbital tentacle whose length equals two-thirds diameter of eye; a short four-fringed tentacle at nostril; a row of small movable teeth in jaws, with the posterior canines present; dorsal fin notched to one-half its depth, the origin of the fin slightly in advance of posterior margin of opercle, and its posterior membrane not extending on the anal, its longest spine 1.75 in head, its longest ray 1.5 in head; origin of anal nearer head than base of caudal, the base of fin 2 in length of fish without caudal; pectoral 1.18 in head; ventral 2 in head; caudal square, its length equal to head; a slight ridge on top of head.

Color in life, ground-color a pale olive-brown, with 9 broad transverse bars of darker brown, fading out below, but above extending well up on the dorsal fin; a round black spot in the fourth transverse bar, a little above middle of body; body thickly sprinkled with small oblong or linear pearly or bluish-white spots, most conspicuous posteriorly, where they form irregular longitudinal rows on the lower part of the body; upper part of head with round white spots, which extend backward above lateral line to posterior end of spinous dorsal; in some specimens numerous small black dots below this on anterior part of body; underside of head pale, with irregular violet streaks; dorsal spines tipped with black; spinous dorsal with irregular horizontal streaks of violet, in some specimens fading to yellowish white; 3 narrow dark longitudinal streaks near the broad pale margin of soft dorsal; caudal and anal plain dusky; pectoral yellowish, with 5 transverse rows of conspicuous dark dots.

In spirits our large series shows a great intergradation of color among the individuals of this species, but the following marks are constant in all: 5 lines of black spots on the pectoral; 2 dusky bands over the head, one directly behind the eye down to angle of mouth, the other over nuchal region on posterior border of preopercle; caudal washed with dusky; anal with a dusky wash on entire fin; body grayish, slightly tinted with blue to purplish, some specimens banded with darker gray, others having scarcely a trace of bands; the type with 9 very distinct vertical dark bands, wider than the interspaces, along the side of body; a number of round yellowish white spots over head and shoulders; some pearl-blue spots on posterior part of body; a round spot on middle of body under anterior of soft dorsal—some of the specimens not showing this spot at all, and others showing it only on one side; dorsal (in type) with the brown bands of body extending up into the fin, a number of rather indistinct narrow longitudinal lines on upper half of fin, the spinous dorsal tipped with black; some specimens with a row of dark spots along middle of dorsal, others with no black dots, but a large number of fine narrow lines on outer half of fin, and between these in many forms our series show an almost perfect gradation; belly usually with a more or less decided purplish wash. The younger individuals show less of color markings, some being almost uniform gray on body.

Twenty-one specimens from Apia. The type is no. 51789, U. S. National Museum, length 3.5 inches. These specimens agree fairly with *Salarias nitidus* of Günther's Fische der Südsee, from Samoa. The type of *Salarias nitidus* from the China Sea is apparently a different species. The species resembles *Alticus periophthalmus*, but may be known at once by the spotted pectoral.

Named for Dr. Barton Warren Evermann.

1589. Alticus caudolineatus (Günther). Tahiti; Samoa; Makatea and Nukahiva (Seale).

Salarias caudolineatus Günther, Fische der Südsee, 209, taf. 116, fig. F, 1876, **Otaheite.**

We have 3 specimens of this very handsome blenny from the reef at Apia, where it is the commonest species in the coral pools, and 7 specimens from Pago Pago.

Life colors of a specimen from Apia, gray; lengthwise dark olive streaks like pencil-marks on side; no bright colors except on the crest, which is edged with orange-red; an orange dash on eye above; 9 transverse double brown bars on side, running from base of dorsal to the lowest lengthwise streak; caudal with from 7 to 9 transverse rows of dark dots; dorsal pale; 3 rows of small dark dots running longitudinally across both dorsals; traces of 2 more rows on the soft dorsal in some specimens; anal pale, with a row of faint brown dots posteriorly, near the base of the rays; pectoral pale, unspotted.

1590. Alticus aneitensis (Günther). Aneiteum.

Salarias aneitensis Günther, Fische der Südsee, 205, taf. 118, fig. A, 1876, **Aneiteum.**

1591. Alticus gibbifrons (Quoy & Gaimard). Hawaii; Marcus I.

Salarias gibbifrons Quoy & Gaimard, Voy. Uranie, 253, 1824, **Maui.** Snyder, Bull. U. S. Fish Comm., XXII, 1902 (1904), 536, Honolulu, Hilo; not of Cuvier & Valenciennes.
Entomacrodus gibbifrons, Bryan & Herre, Bishop Museum, II, 1903, 138, Marcus I.
Salarias saltans Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (1904), 508, fig. 48 (male), **Honolulu.**
Salarias rutilus Jenkins, op. cit., 509, fig. 49 (female), **Honolulu.**

1592. Alticus striatus (Quoy & Gaimard). *Mano'o a'au.* Samoa; Nukahiva (Seale).

Salarias striatus (Quoy & Gaimard) Cuvier & Valenciennes, Hist. Nat. Poiss., XI, 309, 1835, **Ile de France.**
Salarias marmoratus, Gunther, Fische der Südsee, 204, taf. 116, fig. B; not type.

Two specimens from Aua in Tutuila, the species occurring in the sea along the "iron-bound coast", not in the coral reefs.

Color in life, white ground-color with dark spots on side with purplish blue tinge; spots on caudal smoky; belly white; head with a weak bluish streak behind eye; lower side of head with 3 white stripes radiating from the throat on each side; dorsals irregularly and obliquely streaked with dark; caudal with about 6 irregularly transverse rows of dark spots; anal pale, its edge dusky; pectoral plain, uncolored.

Dr. Günther has evidently confused this species with *Alticus marmoratus*, which was described by Bennett from the Sandwich islands, and has since been collected there by Dr. Jenkins, by Jordan & Evermann, and by Professor Snyder at Laysan Island. Fishes from other localites described under the name of *S. marmoratus* belong to still other species. This is apparently the species called *Salarias striatus* by Quoy & Gaimard. but it is probably different from *Salarias arcuatus* Bleeker. It is called "the outside skippy", *mano'o a'au* in the Samoan vernacular.

1593. Alticus marmoratus (Bennett). Hawaii; Laysan.

Salarias marmoratus Bennett, Zool. Journ., IV, 35, **Hawaii**; not of Günther. Snyder, Bull. U. S. Fish Comm., XXII, 1902 (1904), 536, Laysan.

1594. Alticus griseus (De Vis).

Salarias griseus De Vis, Proc. Linn. Soc. N. S. W. 1884, 450, **South Seas.**

This scantily described species is unknown to us. The presence of tentacles at the nape indicates a resemblance to *Alticus marmoratus*.

1595. Alticus coronatus (Günther). Solomon Is.; Samoa; Nukahiva (Seale).

Salarias coronatus Günther in Brenchley, Cruise of the Curaçoa, 424, pl. 33, fig. B, **Solomon Is.** Günther, Fische der Südsee, 206, taf. 116, fig. E, Solomon Is.

Of this rare fish we have 14 examples from the coral reefs at Apia. Color in life, light green with about 8 paired cross-bands of reddish brown; stripes across chin and throat dusky; sides and top of head with small round whitish spots, which extend backward along base of spinous dorsal. *Alticus evermanni* has the same kind of dots on its head, but they are differently arranged.

In alcohol the paired cross-bands fade, leaving 2 longitudinal rows of small brown dots, prominent only posteriorly; dorsals pale, colorless; dorsal spines tipped with black; anal pale, dusky-edged; caudal pale, unspotted; pectoral with from 3 to 5 irregular transverse rows of dark brown spots.

1596. Alticus variolosus (Cuvier & Valenciennes). Guam; Samoa; Tonga; Hawaii.

Salarias variolosus Cuvier & Valenciennes, Hist. Nat. Poiss., XI, 317, pl. 330, 1836, **Guam.** Günther, Fische der Südsee, 203, taf. 116, fig. A, Samoa, Tonga, Society Is. Fowler, Proc. Ac. Nat. Sci. Phila 1900, 518, Sandwich Is. Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (1904), 507, Honolulu.
Salarias nigripes Seale, Occ. Papers Bishop Museum, vol. I, no. 3, 1901, 127, Guam.

Eight examples of this widespread Polynesian blenny were obtained at Apia, from the lava rocks.

Color in life, jet-black with brownish shade; pectoral edged below with cherry-red, spinous dorsal with brownish; the upper anterior portion abruptly pale, its boundary extending from the tip of near the last spines forward to the base of the first; no distinct spots; caudal above and below with pale dull olive; upper portion of caudal always more or less pale, the pale color not sharply defined; fins otherwise nearly black; body unmarked; 7 narrow dark blue cross-bars on body and a dark blue line from nape to opercle.

1597. Alticus alboguttatus (Kner). Samoa; Fiji.

Salarias alboguttatus Kner, Sitz. Ak. Wiss. Wien, LVI, 1867, 16, pl. 4, fig. 4, **Samoa.** Günther, Fische der Südsee, 206, taf. 118, fig. B, Kandavu.

Of this pretty little blenny but 3 specimens have previously been collected, 1 at Samoa and 2 at Kandavu, one of the Fiji Islands. We have 18 specimens from Apia and 3 from Pago Pago.

Color in life of a specimen from Pago Pago, a faint red blotch behind eye; eye with 7 red spots in iris; body pale olivaceous green, with white spots; a large blue spot on each side of the throat.

Another specimen from Apia in life was olivaceous brown, with pale oblong horizontal spots on sides; head speckled with small round white spots; a large steel-blue spot on each side of the throat; faint orange spots on base of dorsal; soft dorsal and caudal pale; faint olive bars on middle of caudal; tip of caudal cherry-red; anal dusky; pectoral pale, its base spotted like head.

1598. Alticus guttatus (Cuvier & Valenciennes). Vanicolo; Samoa.

Salarias guttatus Cuvier & Valenciennes, Hist. Nat. Poiss., XI, 308, **Vanicolo.** Gunther, Cat., III, 250 (copied). Gunther, Fische der Sudsee, 204.

This rare little fish was described from 2 small specimens from Vanicolo, and seems not to have been collected since. We have 2 specimens, 25 millimeters in length, from Apia. They differ from the types in having a small crest, colored like the body.

Color in alcohol, ground-color of body uniform pale brown, with about 4 rows of dark-brown spots, made up of numerous fine specks, the spots in the two lower rows much larger than those in the upper rows; 2 rows of oblong, pearly white spots, commingled with the two lower rows of brown spots; above these are numerous small pearly spots; head covered with many small pearly and brown specks, commingled; a dark streak behind eye; behind this a dark band extending from nape diagonally downward and forward to throat; under side of head pale, with white specks; a small black spot on each side of throat; chin and upper lip with black streaks; belly pale; margin of dorsal dark;

a narrow dark longitudinal band near base of soft dorsal; anal clear, its edge dusky; caudal clear; basal portion of pectoral covered with pearly white spots, otherwise clear. Another specimen agrees exactly with the above, but lacks the pearly spots.

1599. Alticus thalassinus Jordan & Seale, new species. Samoa.

Head 4.5 in length; depth 5; eye 4 in head; dorsal XII, 14; anal 18; interorbital one-half as wide as eye; a short curved lateral line ending under tenth dorsal spine.

Body elongate, compressed, the head blunt, the anterior profile almost vertical; an outer row of fine movable teeth in the jaws; posterior canines present; a short, fringed orbital tentacle, its length less than width of eye; a minute fringed tentacle at nostril; dorsal notched to about one-half its depth; origin of dorsal directly above posterior margin of opercle, its posterior membrane not united with caudal, its longest ray 1.75 in head; origin of anal midway between snout and base of caudal, its longest rays 2.2 in head; total length of pectoral about equal to head, ventral small, slightly anterior to pectoral, 2.25 in head; caudal rounded 1.14 in head.

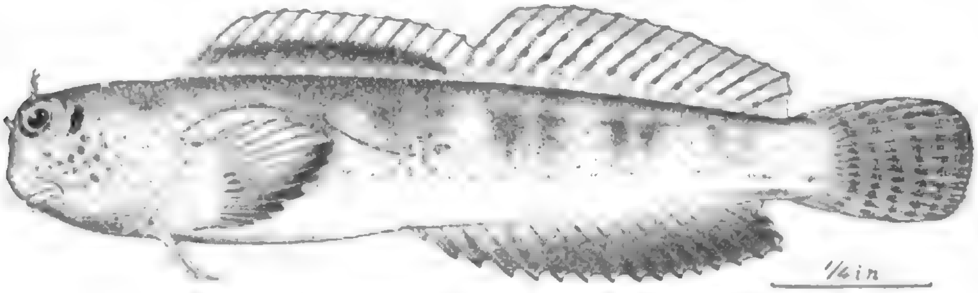


FIG. 103.—*Alticus thalassinus* Jordan & Seale, new species. Type.

Life colors, green, with dark brown bands and many spots arranged in cross-series; chin and spot behind eye blackish; a broad dark band on basal half of spinous dorsal; margin clear; soft dorsal with 3 longitudinal rows of large dark spots, its margin dusky; caudal irregularly streaked with transverse bars of brownish black; anal blackish brown, the tips of the rays white; lower part of pectoral dusky; upper portion clear.

Color in spirits, whitish, with slight wash of pale green, head rather thickly covered with round spots made up of minute brown dots like pin-pricks, a deep black spot the size of pupil just posterior to eye; upper half of body with scattered brown dots assuming indistinct band-like arrangements on sides; chin with a dark blotch; caudal with 6 brown cross-bands; spinous dorsal with dark shading through its center; soft dorsal with about 3 rows of brown dots and a dark margin to fin; anal dusky shaded, with lighter margin; pectoral and ventral slighty shaded with dusky; iris golden.

Three specimens from Apia. The type is no. 51795, U. S. National Museum, length 1.5 inches.

1600. Alticus musilæ Jordan & Seale, new species. Samoa.

Head 4.1 in length; depth 4.1; eye 2.1 in head; dorsal XII, 14; anal 17; interorbital one-half width of eye.

Body elongate, compressed; profile of head vertical; a short lateral line, ending brokenly under the posterior margin of spinous dorsal; an outer row of moveable teeth in each jaw; posterior canines present; origin of dorsal on line with posterior margin of opercle, the fin not extending posteriorly upon base of caudal, its longest spine 2.2 in head, the fin notched to its base; a short fringed orbital tentacle, and a very short fringed nasal tentacle; pectoral fin equal to head; ventral small, situated anterior to pectoral, its length equal to postocular part of head; base of anal about 3 in length of fish, its longest ray 2.25 in head; caudal rounded, its length equal to head.

Life colors, light cherry-red, 8 pairs of bars of crimson brown, a red brown spot behind eye; fins pale reddish, dotted, the caudal whitish; cirri red; front and top of head thinly spotted with small reddish brown specks; chin and sides of head thickly spotted; a few brown spots scattered about over body; from 1 to 3 larger, round blue-black dots on body under pectoral.

Color in spirits, whitish with slight wash of pale green; head and shoulders with a few small scattered brown dots; a small black spot behind eye, less than size of pupil; body with 2 or 3 longitudinal rows of brown dots; fins without color or markings except a few small irregular dark spots on dorsal and caudal.

Four specimens from Apia. The type is no. 51790, U. S. National Museum, length $1\frac{3}{16}$ inches.

The species is named for Musila, of Apia, a young Samoan of fine parts whom we found efficient as a fisherman.

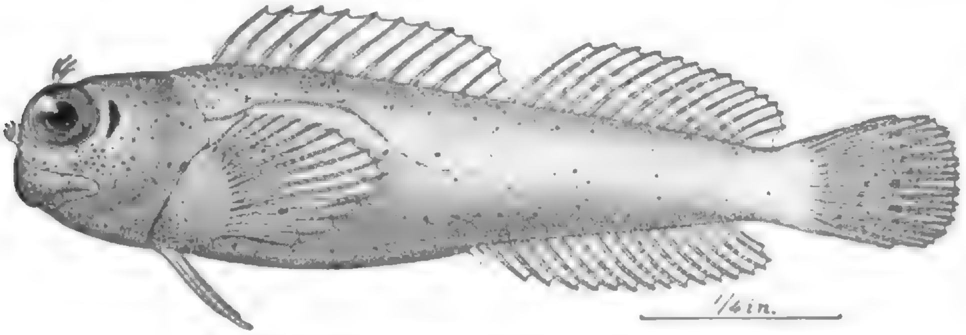


FIG. 104.—*Alticus musilæ* Jordan & Seale, new species. Type.

1601. Alticus sebæ (Cuvier & Valenciennes). Fiji; Tahiti; Samoa (Günther).

Salarias sebæ Cuvier & Valenciennes, Hist. Nat. Poiss., XI, 323, 1836, **East Indies**. Kner, Sitz. Ak. Wiss. Wien 1868, 41, Fiji. Günther, Fische der Südsee, 202, Samoa, Fiji, Tahiti.

This species, known by the lengthening of the first 1 to 3 dorsal spines, was not taken by us.

1602. Alticus sealei (Bryan & Herre). Marcus I.

Entomacrodus sealei Bryan & Herre, Occ. Papers Bishop Museum, II, 1903, 128, **Marcus I.**

SALARIAS Cuvier. *Mano'o.*

Scartes Jordan & Evermann, Check-List Fishes, 471, 1896 (*rubropunctatus*), name preoccupied by *Scartes* Swainson, 1829, a genus of mammals.

Scartichthys Jordan & Evermann, Fishes North and Mid. Amer., III, 2395, 1900 (*rubropunctatus*). Not *Salaria* Forskål = *Blennius*.

1603. Salarias zebra Vaillant & Sauvage. Hawaii.

(*Salarias cypho* Jenkins, Honolulu.)

This species is very abundant in the rock-pools of the lava about Hawaii, being the commonest of all the blennies in that region. It has not been found elsewhere.

1604. Salarias sertatus Garman. Fiji.

Salarias sertatus Garman, Bull. Mus. Comp. Zool., XXXIX, 1903, 237, Fiji.

This species, which we have not seen, resembles *Alticus saliens* in form and in habits, but is uniformly colored.

1605. Salarias lineatus Bleeker. Samoa; Faté (Seale); East Indies.

Salarias lineatus Bleeker, Verhand. Batav. Genootsch., XXII, Blenniidæ and Gobiidæ, 18. Günther, Cat., III, 254, Java. Day, Fishes of India, 332, pl. LXX, fig. 8 (male), Red Sea, Andaman Is., Malay Archipelago.

We have 5 specimens from Pago Pago and one from Apia. Life colors of one from Pago Pago, dark olive; side with about 6 to 8 dark lengthwise stripes, the 3 or 4 lowermost more continuous and regular, the upper very wavy, these interosculating with each other so that the back and region behind head show dark network; 6 paired blackish cross-shades on back and sides; fins dull olive; dorsals separate, the first with oblique dashes at base and a dusky edge, second with oblique streaks like those on body, the edge pale; caudal dusky; anal pale, the edge dark; pectoral and ventral rather pale; head with vertical marblings; 2 converging lines on base of caudal. Dorsal XII-24. Differing from current descriptions in having no crest; tentacles small. The other specimens have a high crest.

Another specimen from Pago Pago was blackish olive, with a bright yellow or tawny shade in life; 5 or 6 diffuse cross-shades on back; side with 4 or 5 series of short oblong horizontal dashes of paler olive, forming interrupted lines, the lowest nearly continuous; some dark cross-shades on lower part of head; fins dark olive; dorsal and caudal pale edged; tentacle and crest dull olive. Dorsal notched, the spines higher than the soft rays.

1606. Salarias fasciatus (Bloch). Samoa; Tonga; Vanicolo; Ponape; East Indies.

Blennius fasciatus Bloch, II, 112, taf. 162, fig. 1, 1870, **Japan.**

Salarias quadripinnis Rüppell, Atlas Fische, 112, taf. 28, fig. 2, 1828, **Red Sea.** Cuvier & Valenciennes, Hist. Nat. Poiss., xi, 318, 1836, Timor, Tongatabu, Vanicolo.

Salarias fasciatus Cuvier & Valenciennes, op. cit., 324, 1836. Günther, Fische der Südsee, 201, taf. 115, fig. o, Ponape.

Salarias semilineatus Kner, Sitz. Ak. Wiss. Wien, LVI, 1867, fig. 3, **Samoa.**

Life colors of a specimen from Apia, brown, with oblong bluish spots; numerous small dark dots and dashes on sides, back of head and above pectoral, soon fusing and becoming lines which extend backward to below middle of soft dorsal; dorsal brown with greenish white spots and brown dots, its edge creamy red; caudal olive, speckled with brown and whitish, its upper edge washed with cherry-red; anal like dorsal, dusky-edged; pectoral and ventral barred; belly livid; eight dark shades at base of dorsal.

We have about 80 specimens of this species from the coral reef at Apia, where it is very common; we have also 6 specimens from Pago Pago.

1607. Salarias biseriatus (Cuvier & Valenciennes). *Mano'o a'au.* Tahiti; Samoa.

Salarias biseriatus Cuvier & Valenciennes, Hist. Nat. Poiss., xi, 316, 1828, **Tahiti.** Kner, Novara Reise, Fische, 197, taf. 8, fig. 4, 1865, **Tahiti.** Günther, Fische der Südsee, 208, **Tahiti.**

Life colors of a specimen from Pago Pago, blackish olive, violaceous below; sides with 4 rows of violet-white round spots, the third series most distinct and regular, the spots of the fourth row larger and more diffuse; fins all dark, nearly plain.

Another example was blackish olive with 8 to 11 white partial bands across belly and base of anal, often not distinct before vent; head with small bluish white spots; a row of these spots more distinct along upper line of ventral bars, others on sides forming a second irregular row, usually gathered in pairs, one above the other, about 6 pairs of dark blotches along base of dorsal; fins dark, mottled with darker; a black spot on front of first dorsal; soft dorsal with oblique pale streaks; caudal dusky olive; ventral black; pectoral olive, with fine white dots. Dorsal divided, xii, 18.

A young individual from Pago Pago was violet-black or brown, with some 7 or 8 pale cross-streaks, violet-tinged, narrower than the interspaces; 4 or 5 sharply defined white spots along side; head with violaceous and greenish mottlings; caudal light yellow; dorsals dusky, mottled; anal pale; ventral and anal dusky-translucent. Dorsal divided; no crest.

Two specimens from near Aua, on the north shore of Tutuila, together with 152 other examples from the same place, taken with dynamite among the lava rocks on the "iron-bound coast." One specimen from Apia.

1608. Salarias sindonis Jordan & Seale, new species. Samoa.

Head 4.2 in length; depth 5.75; eye 3 in head; interorbital space scarcely equal to eye; dorsal xii, 19; anal 21; lateral line short, ending under posterior part of spinous dorsal.

Body elongate, compressed, the anterior profile of head rounded, the forehead not projecting; angle of jaws under middle of eye; a short, simple orbital tentacle and a minute, fringed nasal tentacle; teeth in jaws in a single series, no posterior canines; dorsal fin incised to one-half its depth, its origin over posterior margin of opercle, and its distal end terminating some distance anterior to caudal base, the greatest vertical height of the fin about 3.5 in head; origin of anal nearer tip of snout than base of caudal, considerably in advance of soft dorsal, the fin long, its base equal to distance from tip of snout to origin of the fin, its longest ray 2.5 in head; pectoral equal to length of head; caudal rounded, 1.25 in length of head.

Life colors, translucent gray, the head black, the body with about 6 pairs of dark cross-bands; conspicuous dark spots along base of dorsal; fins all pale, the concave caudal whitish; top of head with many round, dark-brown dots; on nape these form a crescent, the horns of which reach posterior margins of eyes; within this crescent the dots form a large spot; body and fins everywhere thickly sprinkled with minute black specks.

Another specimen was dark blackish green, with darker cross-bands and no other colors; top of head and nape covered with many comparatively large, round, brown dots; body and fins everywhere covered with minute black dots.

Color in spirits, ground-color yellowish white, thickly punctulate with minute dark dots, these taking the form of numerous (18–20) rather irregular vertical bands on sides of body, some of the bands more or less connected at top; in older examples the bands seem to group themselves in pairs and become fewer in number; a characteristic oblique black band on the head from nuchal region through eye to middle of each maxillary; the dark markings of body extending a little way into dorsal, the fin also shaded slightly with minute dark dots; anal white, with slight tint of dusky; pectoral, ventral, and caudal whitish, without distinct markings.

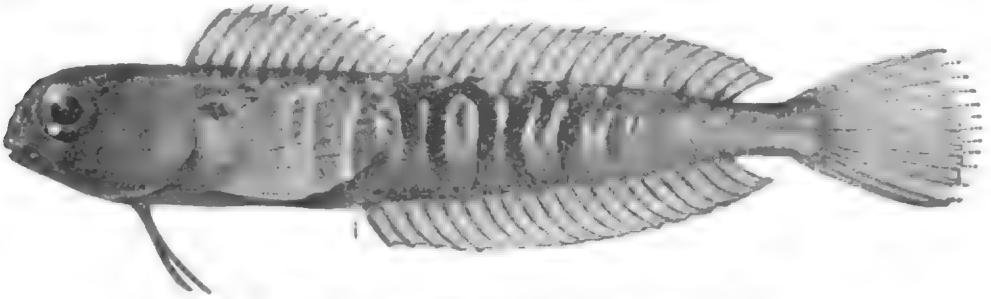


FIG. 105.—*Salarias sindonis* Jordan & Seale, new species. Type.

Numerous specimens (50) collected at Pago Pago, by Mr. Michitaro Sindo, for whom the species is named. The type is no. 51792, U. S. National Museum, length 0.99 inch.

1609. Salarias atkinsoni Jordan & Seale, new species. Samoa.

Head 3.75 in length; depth 3.75; eye 2.75 in head; interorbital equal to one-half of eye; dorsal XIII, 17; anal 21; a short lateral line ending under eighth dorsal spine.

Body elongate, compressed, rather short; anterior profile of head vertical; the angle of mouth under posterior third of eye; depth of caudal peduncle 2.75 in head; a simple, short orbital tentacle, a small fringed one at nostril; teeth in a single row in each jaw, no posterior canines; dorsal fin incised almost to base, the incision being broadly rounded; origin of dorsal about 1 spine in front of posterior margin of opercle, its distal end reaching to base of caudal, not attached to caudal by membrane; longest spine of dorsal 2.3 in head, longest ray 1.85 in head; origin of anal slightly anterior to dorsal incision, its base 2.5 in fish without caudal, its origin an equal distance from tip of snout and base of caudal, its longest ray 2.5 in head; pectoral scarcely equal to length of head, its tip under tenth dorsal spine; ventral about 1.75 in head; caudal rounded, 1.25 in head.

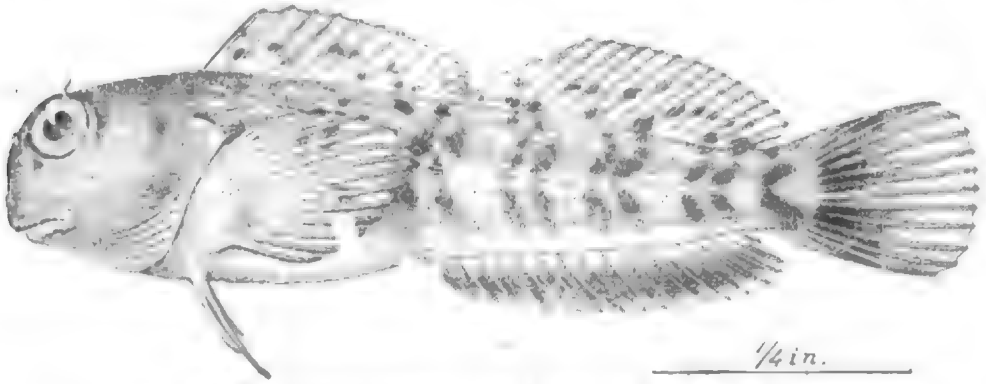


FIG. 106.—*Salarias atkinsoni* Jordan & Seale, new species. Type.

Color in spirits, dull whitish with slight tint of pale green; 6 very distinct pairs of dark bands on sides, which are divided in the middle by a narrow space, the portion of line above being sloped obliquely forward, those below obliquely back; no marking on chin or throat; dorsal fin with distinct brown spots scattered through it; anal with a narrow margin of white and a broad intramarginal band of black, fading into whitish at base of fin; caudal with dusky blotch at base; other fins uncolored.

One specimen from Pago Pago, type no. 51791, U. S. National Museum, length 0.98 inch. Named for the artist, Mr. William Sackston Atkinson.

1610. Salarias rivulatus Rüppell. Samoa; Paumotu Is.; Tahiti; East Indies.

Salarias rivulatus Rüppell, Atlas, Africa, 114, 1828, **Red Sea.**

Salarias quadricornis Cuvier & Valenciennes, Hist. Nat. Poiss., XI, 329, pl. 329, 1836, **Ile de France.** Günther, Cat., III, 255, Indian Ocean, Chinese Sea. Günther, Fische der Südsee, 209, taf. 117, fig. B, Upolu, Paumotu, Tahiti.

Life colors of a specimen from Pago Pago, dark olive; several pairs of darker brown cross shades, the last 3 resolving themselves into oblique streaks upward and backward; soft dorsal with oblique dark streaks; caudal plain; anal dusky-edged. No crest; dorsal divided.

Another specimen from the same locality was olive, with about 8 pairs of dark cross-bars, with cross-streaks between, the last obscure; a dark oblique streak behind eye; dorsal with horizontal rows of light olive spots, these more oblique on second dorsal; anal dusky-edged, with 2 pale blue longitudinal lines; fins otherwise dusky olive.

A third specimen from Pago Pago was blackish olive in life, with a series of dark marblings and spots above lateral line, most distinct posteriorly, fainter below; dorsals similarly marbled; head dark; cirri dusky; fins all blackish, uncolored; anal with 2 faint pale longitudinal lines. A younger one shows faint paired dark cross-bands.

About 75 specimens from the coral reefs of Apia and Pago Pago, where it is very abundant.

1611. Salarias edentulus (Bloch & Schneider). Huahine; Samoa; Paumotu; Bonham; Rarotonga; Faté; Nukahiva and Makatea (Seale); East Indies.

Blennius edentulus Bloch & Schneider, Syst. Ichth., 172, 1801, **Huahine.**

Salarias forsteri Cuvier & Valenciennes, Hist. Nat. Poiss., XI, 315, 1836; described from Forster's specimen from Huahine.

Blennius truncatus Forster, Descr. Anim., 231, 1844, **Huahine.**

Salarias edentulus, Günther, Cat., III, 252, 1861, Polynesia, eastern parts East Indies. Günther, Fische der Südsee, 206, taf. 117 fig. A, Samoa, Paumotu, Bonham, Rarotonga.

Life colors of a specimen from Apia, dark olive, the body and fins much spotted with bright reddish brown; belly livid bluish; caudal pale, slight yellowish below; anal pale-edged.

A specimen from Pago Pago had several dark, irregular, paired cross-bands on body, with dark brown dots along base of anal and on caudal peduncle; dorsal divided, with oblique rows of black dots besides numerous whitish ones; anal with 2 rows of dots and a whitish edge; pectoral and ventral plain olive; no crest; tentacles small.

Another Apia specimen was dark bluish-olive, with dark-brown markings; head and anal blue-black; caudal mostly black; caudal peduncle with several rows of brown dots; spinous dorsal with 2 longitudinal rows of dark dots; soft dorsal with several oblique rows of dots; caudal and pectoral plain dusky; anal dusky, pale-edged.

We have 60 specimens from Apia and Pago Pago, where it swarms in the crevices of the coral reefs.

1612. Salarias meleagris Cuvier & Valenciennes. New Caledonia; New Hanover; Nukahiva and Makatea (Seale).

Salarias meleagris Cuvier & Valenciennes, Hist. Nat. Poiss., XI, 232, 1836, **Tasmania.** Günther, Fische der Südsee, 208, taf. 116, fig. G, New Caledonia, Cape York, Zanzibar. Peters, Berl. Mon. 1876, 841, New Hanover.

This species, unknown to us, is recorded from Melanesia and Polynesia, but these specimens may be distinct from the original type, which came from Tasmania.

1613. Salarias garmani Jordan & Seale, new species. Samoa.

Head 4.18 in length; depth 5; eye 3 in head; interorbital equal to one-half of eye; dorsal XIII, 21; anal 24; a short, indistinct lateral line ending under the ninth dorsal spine; a short, simple tentacle over eye, another over nostril.

Body elongate, compressed, the anterior profile of head vertical; caudal peduncle about equal to eye; angle of jaws under posterior third of eye; teeth in jaws in single series, no posterior canines; dorsal fin incised two-thirds of its height, the incision being posterior to origin of anal; origin of dorsal directly over posterior margin of opercle, its distal end at base of caudal, the membrane not attached to caudal fin, the height of longest dorsal spine 2.1 in head, and of the longest ray 1.75 in head; anal fin long, its base 2.2 in length of fish without the caudal, its origin being under base of tenth dorsal spine and nearer tip of snout than base of caudal by a distance about equal to depth of caudal peduncle; longest ray of anal 1.75 in head; pectoral slightly longer than head; ventral 1.95 in head; caudal rounded, 1.2 in head.

Color in life gray-green, everywhere finely punctate with black; indications of broad transverse bars, most pronounced on middle of body; subsurface spots lilac-red anteriorly, orange-red posteriorly; anterior two-fifths of body white below; dorsal fin clear, with many fine black specks, more or less definitely arranged in 2 longitudinal rows; other fins all clear, with numerous tiny black specks; on anal they form a dusky submarginal band, the tips of the rays white.

Color in spirits, dull light gray with a wash of pale green, slightly darker above; 7 pairs of indistinct vertical bands of darker coloring along sides, a distinctive brown band from lower anterior margin of eye vertically down to middle of each maxillary; no markings on chin or throat; dorsal with numerous, more or less regular brown spots; 2 dusky blotches on base of caudal; otherwise the fins are without distinct markings of any kind.

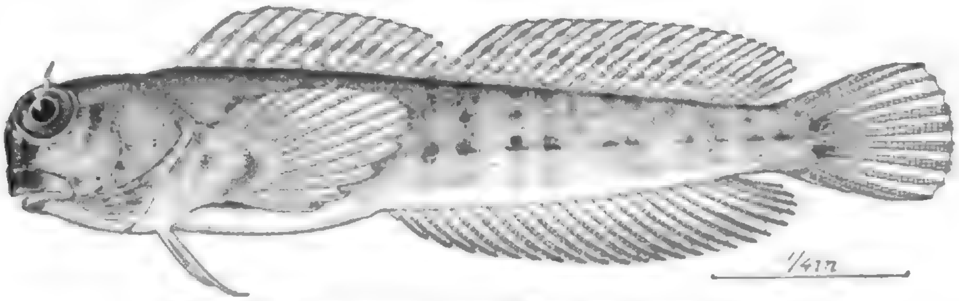


FIG. 107.—*Salarias garmani* Jordan & Seale, new species. Type.

One specimen, the type, no. 51792, U. S. National Museum, from Apia, length 1.2 inches. Named for Prof. Samuel Garman.

1614. Salarias hasselti Bleeker. Fiji; Loyalty Is.; Faté (Seale).

Salarias hasselti Bleeker, Nat. Tijds. Ned. Ind., I, 257, fig. 14, **Java, Sumatra, Cocos.** Günther, Fische der Südsee, 210, Fiji, Loyalty Is.

1615. Salarias bryani Jordan & Seale, new species. Samoa.

Head 4 in length; depth 5.5; eye 3.1 in head; interorbital very narrow, less than width of pupil; dorsal XII, 22; anal 21; lateral lines short, ending near tip of pectoral.

Body oblong, compressed, anterior profile of head rounded; forehead scarcely projecting over mouth; angle of jaws under posterior margin of eye; a short simple tentacle over eye and a minute fringed tentacle at nostril; teeth in jaw in a single series; no posterior canine teeth; dorsal fin incised almost to base; its origin a little anterior of posterior margin of opercle, its incision directly over origin of anal, its posterior extremity ending on base of caudal but not attached to caudal; base of anal 2.45 in length of fish, its origin nearer tip of snout than to base of caudal, the distance between tip of snout and origin of the fin, considerably greater than base of fin; longest ray of anal 2 in head; pectoral equal to head; ventral minute, 1.85 in head; caudal rounded, 1.1 in head.

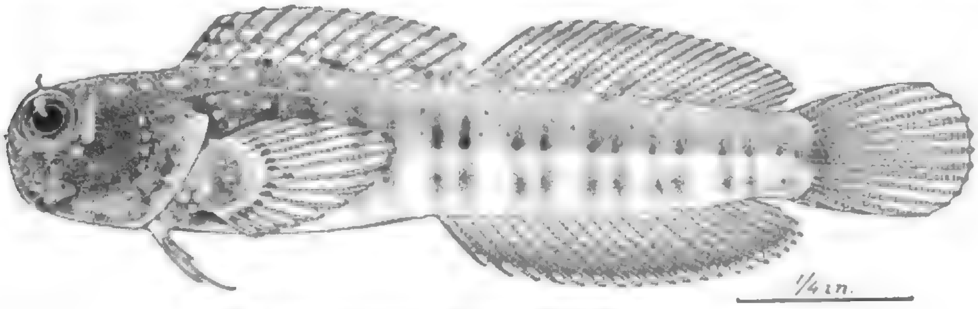


FIG. 108.—*Salarias bryani* Jordan & Seale, new species. Type.

Color in spirits dull light gray, with 8 vertical double dark bands on side, these bands about equal to interspaces; head and shoulders punctulate with yellowish white spots; head shaded darker than other parts; 2 dusky bands under chin; a single row of rather distinct black dots across pectoral; a few scattered dusky blotches on spinous dorsal; anal with margin of white with intramarginal area of dusky, other fins unmarked.

One specimen, the type no. 31794, U. S. National Museum, from Apia, length 1⅜ inches. Named for William Alanson Bryan, curator in the Bernice Pauahi Museum, in Honolulu

1616. **Salarias gilberti** Bryan & Herre. Marcus I.

Salarias gilberti Bryan & Herre, Occ. Papers Bishop Museum, II, 1903, 137, **Marcus I.**

1617. **Salarias marcusi** Bryan & Herre. Marcus I.

Salarias marcusi Bryan & Herre, Occ. Papers Bishop Museum, II, 1903, 137, **Marcus I.**

1618. **Salarias paulus** Bryan & Herre. Marcus I.

Salarias paulus Bryan & Herre, Occ. Papers Bishop Museum, II, 1903, 136, **Marcus I.**

1619. **Salarias holomelas** Günther. Palau Is.; Vavau.

? *Salarias fuscus* Rüppell, Neue Wirbelthiere, Fische, 135, taf. 32, fig. 2, 1835, **Red Sea.**
? *Salarias ruficaudus* Cuvier & Valenciennes, Hist. Nat. Poiss., XI, 328, 1836. **Red Sea.**
? *Salarias phæosoma* Bleeker, Batoe, 317, **Batoe.**
Salarias holomelas Günther, Ann. Mag. Nat. Hist. 1872, **Cebu.**
Salarias fuscus, Günther, Fische der Südsee, 202, taf. 116, fig. C, 1873, **Palau**, Vavau.

This strongly marked species is not represented in our collections. It is close to *Salarias fuscus* of the Red Sea, but we may retain it as a different species, as according to Dr. Günther the caudal is black in *S. holomelas* and yellow in *S. fuscus.*

1620. **Salarias atratus** Macleay. New Guinea.

Salarias atratus Macleay, Proc. Linn. Soc. N. S. W. 1882-3, 261.

1621. **Salarias goesi** Bleeker. New Guinea.

EXALLIAS Jordan & Evermann.

Exallias Jordan & Evermann, Bull. U. S. Fish Comm., XXIII, 1903 (1905), 503 (*Salarias brevis* Kner).

1622. **Exallias brevis** (Kner). *Mano'o gatala.* Samoa; Hawaii.

Salarias brevis Kner, Sitz. Ak. Wiss. Wien 1866, 334, taf. 16, fig. 18, **Savaii.** Günther, Fische der Südsee, 203, taf. 118, fig. C; after Kner. Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (1903), 506, Honolulu.

Of this species only 15 specimens are known, 14 from Hawaii, the other from Savaii. We obtained no specimens in Samoa, but Dr. T. D. Wood obtained in Honolulu one specimen, which is now in the Stanford University Museum.

PETROSCIRTES Rüppell.

Petroscirtes Rüppell, Atlas Fische, 110, 1828 (*mitratus*).
Blennechis Cuvier & Valenciennes, Hist. Nat. Poiss., X, 1836, 279 (*filamentosus*).
Aspidontus (Cuvier) Quoy & Gaimard, Voy. Astrolabe, III, 1834, 719 (*tæniatus*).
Omobranchus (Ehrenberg, pl. XI, fig. 91) Swainson, Class. Fishes, II, 1839, 274 (*fasciolatus*).

1623. **Petroscirtes longifilis** Kner. Samoa.

? *Petroscirtes mitratus* Rüppell, Atlas Fische, III, taf. 28, fig. 1, 1828, **Red Sea.** Günther, Fische der Südsee, 198, **Samoa.**
? *Petroscirtes barbatus* Peters, Wiegmann's Archiv, 1855, 248, **Mozambique.**
? *Petroscirtes hyperiopterus* Bleeker, Amboina, VI, 428, **Amboina.**
Petroscirtes longifilis Kner, Sitz. Ak. Wiss. Wien 1866, LIV, 5, **Samoa.**

Life color of a specimen from Apia olivaceous, with broad dark cross-bars; head much banded below; dorsal yellowish, barred and spotted with black; anal similar; caudal pale with cross-bars of dots; ventral long, dotted or barred, as is the pectoral. Dorsals 2, the first short and elevated in front.

We have 2 specimens of this fish from Apia. Dr. Günther identifies it with *P. mitratus*, thus throwing nearly all the species with elevated anterior dorsal spines into one, an arrangement open to serious question. We may provisionally retain the name *longifilis*, applied to a Samoan specimen.

1624. **Petroscirtes filamentosus** (Cuvier & Valenciennes). Papau; Paumotu Is.; Huahine; East Indies.

Blennechis filamentosus Cuvier & Valenciennes, Hist. Nat. Poiss., XI, 280, 1836, pl. 326, **Papua.**
Petroscirtes filamentosus, Gunther, Fische der Sudsee, 196, taf. 114, fig. B, 1873, Paumotu, Huahine.
Petroscirtes rostratus Bleeker, Act. Soc. Sci. Ind. Neederl., II, 62, **Amboina.**

1625. Petroscirtes azureus Jordan & Seale, new species. Samoa.

Head 4 in length; depth 5.5; eye 4.5 in head; snout projecting, 3.20 in head; dorsal 37; anal 27; interorbital equal to orbit; chin with 6 small barbels.

Body elongate, compressed, naked; depth of caudal peduncle 2.2 in head; mouth narrow, situated on the ventral surface of head, overhung by snout; a single outer row of round pointed teeth in each jaw, 18 in upper and 26 or more in lower, with several additional inner rows in lower jaw, an immense curved fang-like tooth on each side of lower jaw, the length of which is two-thirds of eye; one small tooth on head of vomer; a single dorsal fin, whose origin is on nuchal region just above the posterior margin of postorbital, and which terminates at base of anal, its anterior rays not filamentous, the vertical height of the fin about 3.2 in head; origin of anal midway between tip of snout and base of caudal, vertical height of fin equal to orbit; caudal rounded, equal in length to pectoral, 1.65 in head; origin of ventral in front of pectoral, its length 2.18 in head.

Life colors olivaceous, a deep blue-black lateral band, broader and more distinct indigo-color behind; dorsal, anal, and caudal jet-black, edged with white, the indigo-black caudal V-shaped, leaving the angles of the fin broadly white; head with the dark band continued forward as brown, edged above and below with black; pectoral and ventral clear, uncolored.

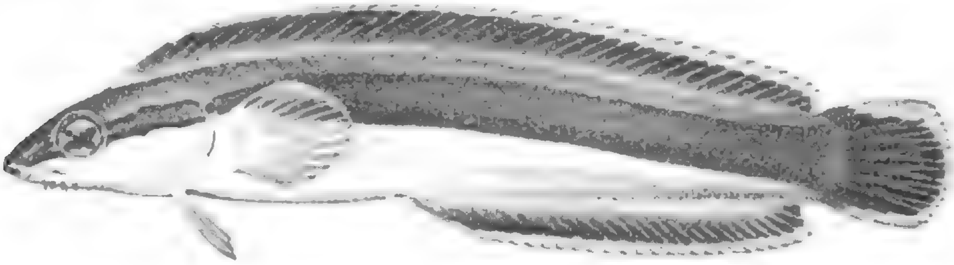


FIG. 109.—*Petroscirtes azureus* Jordan & Seale, new species. Type.

Color in spirits yellowish brown; thorax, belly, and chin lighter, a darker band with black margins from snout to posterior margin of opercle, from this point to the caudal the entire band becoming black and broadening until it occupies the base of caudal and entire fin except the upper and lower posterior margins and tip, which are yellow; anal black with yellow margin; caudal dusky, becoming black posteriorly, with a narrow margin of yellow; pectoral and ventral white.

This handsome fish is close to *Petroscirtes filamentosus*, but differs in having 8 barbels or tentacles on the chin and throat, and in not having the anterior dorsal spines elongate.

One example from Apia, type no. 51796, U. S. National Museum, length 3.75 inches.

1626. Petroscirtes grammistes (Cuvier & Valenciennes). Yap; East Indies.

Blennechis grammistes, Cuvier & Valenciennes, Hist. Nat. Poiss., XI, 285, 1836, **East Indies.**
Petroscirtes grammistes Gunther, Fische der Sudsee, 197, 1873, taf. 115, fig. F. Yap, China.
Petroscirtes anema Bleeker, Amboina and Ceram, 273.

This handsome species, with 3 black stripes, is unknown to us.

1627. Petroscirtes rhynorhynchus Bleeker. Palau Is.; Faté (Seale); East Indies.

Petroscirtes rhynorhynchus Bleeker, Amboina and Ceram, 273. Gunther, Fische der Sudsee, 195, taf. 115, fig. E, Palau.

This species is unknown to us. It has 2 black lateral bands besides 1 on the dorsal.

1628. Petroscirtes tæniatus (Quoy & Gaimard). Tahiti; Papua; Caroline Is.; Tonga; Guam; Paumotu; Fiji; East Indies.

Aspidontus tæniatus Quoy & Gaimard, Voy. Astrolabe, 719, pl. 19, fig. 4, 1834, **Guam.**
Petroscirtes tæniatus Gunther, Fische der Sudsee, 195, Tahiti, Papua, Carolines, Tonga, Paumotu, Fiji.
Petroscirtes paradiseus Bleeker, Amboina, v, 496.

This species we have not seen.

1629. Petroscirtes tapeinosoma Bleeker. Samoa (Günther); Faté; Raiatea and Nukahiva (Seale); East Indies.

Petroscirtes tapeinosoma Bleeker, Amboina, 64, **Amboina.** Gunther, Fische der Sudsee, 195, taf. 115, fig. D, **Apia.**

This species, with 2 black stripes besides 1 on the dorsal, is unknown to us. It is near our *Petroscirtes azureus.*

1630. Petroscirtes atrodorsalis Günther. Samoa. (Pl. LIII, fig. 3.)

Petroscirtes atrodorsalis Günther, Fische der Südsee, 198, taf. 115, fig. B, **Samoa.**

We have 2 specimens of this rare and handsome little fish, from Pago Pago.

Life colors, clear dark blue, becoming golden on caudal peduncle and caudal fin; 2 sky-blue stripes on eye; a black stripe from edge of pupil to origin of dorsal; dorsal with a broad median band of jet-black, its margin white; caudal pale golden; other fins dusky bluish; a black spot in axil of pectoral.

1631. Petroscirtes xestus Jordan & Seale, new species. Samoa.

Head 2.85 in length; depth 2.75; eye 2.2 in head; dorsal 26; anal 17; interorbital equal to eye.

Body elongate, compressed, largest at head; anterior profile rounded, snout less than one-half of eye; angle of jaws below middle of eye; teeth in a single row in jaws, a pair of large curved fang-like canines in each jaw, those of the lower jaw largest; gill-opening reduced to a narrow slit less in width than one-half diameter of eye; a single continuous dorsal fin whose origin is slightly anterior to gill-opening and whose distal end does not extend quite to base of caudal; base of anal fin 3 in length of fish without caudal, its longest ray 3.95 in head; origin of anal much nearer base of caudal than tip of snout, its distal end not reaching quite to base of caudal; pectoral 1.95 in head; ventral 2 in head, their base slightly anterior to base of pectoral; caudal rounded, 1.75 in head.

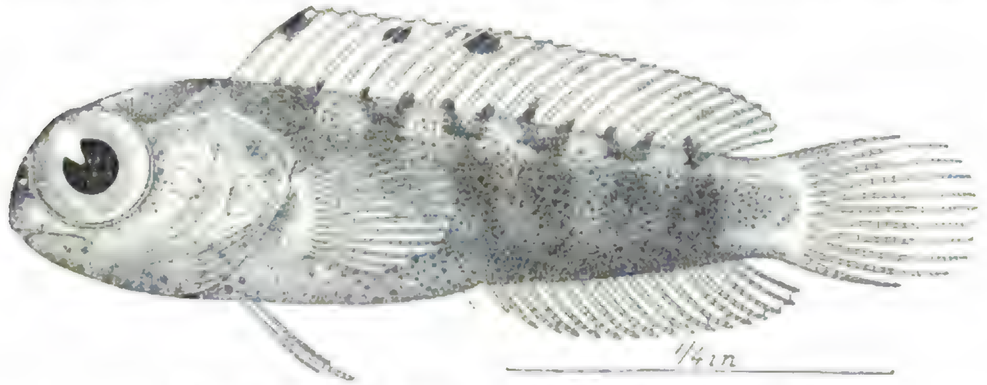


Fig. 110.—*Petroscirtes xestus* Jordan & Seale, new species. Type.

Color in life, light clear brownish red, with a broad silvery lateral stripe from eye to base of caudal; 6 dark cross-shades on body; top of head bright silvery, as if coated with mercury; throat and belly white, sprinkled with silvery spots; dorsal clear with a submarginal row of dark blotches; other fins all clear.

Color in spirits, silvery with small brown spots and shadings, yellowish white along base of dorsal; 7 or 8 incomplete vertical cross-bands on the side about as wide as interspaces, these most distinct at base of dorsal; nuchal region set with a heart-shaped coloring like new silver, a silvery wash less bright on sides of head, thorax, and belly; in front of ventral a number of prominent bright silvery dots with darker margins; dorsal with a few dusky spots, otherwise fins yellowish white.

Two specimens from Pago Pago. The type is no. 51797, U. S. National Museum, from Pago Pago, length 0.56 inch.

1632. Petroscirtes elongatus Peters. Fiji; East coast of Africa.

Petroscirtes elongatus Peters, Wiegmann's Archiv 1855, 249, **Zanzibar, Mozambique.** Günther, Fische der Südsee, 196, **Fiji.**

Petroscirtes oualenensis Günther, Challenger Fishes, 1880, 35, **Fiji.**

1633. Petroscirtes lineolatus Kner. Fiji.

Petroscirtes lineolatus Kner, Sitz. Ak. Wiss. Wien, LVIII, 1868, 331, taf. 6, fig. 17, **Kandavu.** Günther, Fische der Südsee, 197, taf. 115, fig. A (after Kner).

1634. Petroscirtes semilineatus Kner. Fiji.

Petroscirtes semilineatus Kner, Sitz. Ak. Wiss. Wien, LVIII, 1868, 332, **Kandavu.** Günther, Fische der Südsee, 197; after Kner.

1635. Petroscirtes obliquus Garman. Samoa.

Petroscirtes obliquus Garman, Bull. Mus. Comp. Zool., vol. XXXIX, no. 8, 1903, 237, with plate, **Fiji.**

Of this species we have one example from Apia more brightly colored than in Mr. Garman's figure, but with the characteristic oblique streaks.

Color in alcohol olive-brown with darker brown spots and diagonal or angled stripes; a large round dark spot behind eye; under side of head pale, with 5 narrow, dark cross-stripes; belly blue; a row of large dark spots on back and base of dorsal; fin otherwise dusky; margin of spinous dorsal pale; caudal pale, unspotted; anal dusky; pectoral pale, minutely spotted with darker; ventral pale.

1636. Petroscirtes germaini Sauvage. New Caledonia.

Petroscirtes germaini Sauvage, Bull. Soc. Philom. 1883, 156, **New Caledonia.**

This species, cross-banded, is quite unlike any other known to us.

ENCHELYURUS Peters.

Enchelyurus Peters, Berl. Mon. 1868, 268 (*flavipes*).

This genus differs from *Petroscirtes* in having the vertical fins confluent, the body short and deep. The typical species is from the Philippines.

1637. Enchelyurus ater (Günther). Hawaii; Samoa; Tahiti.

Petroscirtes ater Günther, Fische der Südsee, 199, taf. 115, fig. E, 1873, **Tahiti.**
Aspidontus brunneolus Jenkins, Bull. U. S. Fish Comm., XXII, 1902 (1903), 510, fig. 50, **Honolulu.**

This rare little fish seems to be rather common at Samoa. We have 25 examples from Pago Pago and 16 from Apia. Günther describes the ventrals as reaching the anal, but in his figure the fins are much shorter. Our specimens show much variation in this character, some having the ventrals twice as long as others; but 2 examples have them as long as shown in Günther's figure.

Jenkins' specimens from Hawaii, called *Aspidontus brunneolus*, seem to be identical with ours from Samoa.

Color in life of a specimen from Apia, uniform blackish, becoming clear olive green on caudal. Other specimens in alcohol have the head and body uniform black-brown, slightly lighter than fins, which are black.

Family GOBIESOCIDÆ.

CREPIDOGASTER Günther.

1638. Crepidogaster lineatus Sauvage. New Caledonia.

Crepidogaster lineatus Sauvage, Bull. Soc. Philom. 1883, 158, **New Caledonia.**

TRACHELOCHISMUS Brisout de Barneville.

1639. Trachelochismus pinnulatus (Forster). Fiji (Kner, Sitz. Ak. Wiss Wien 1868, 55); New Zealand.

Family CONGROGADIDÆ.

CONGROGADUS Günther.

1640. Congrogadus marginatus Vaillant & Sauvage. Hawaii.

1641. Congrogadus subducens Richardson. New Guinea (Günther); Australia.

Family XENOCEPHALIDÆ.

XENOCEPHALUS Kaup.

1642. Xenocephalus armatus Kaup. New Ireland.

Xenocephalus armatus Kaup, Wiegmann's Archiv, 1858, 86, **New Ireland.** Günther, Cat., IV, 399.

Family FIERASFERIDÆ.

FIERASFER Cuvier.

1643. Fierasfer homei Richardson. Hawaii; Samoa; Fiji; New Britain; New Hanover; Tahiti (Fowler, Proc. Ac. Nat. Sci. Phila. 1900, 523); East Indies, not "Tasmania."

The type locality is Timor, and our species is identified with the one described by Richardson. Richardson's other specimen is doubtless not from Tasmania, and there is no reason for regarding *Fierasfer brandesi* as a species distinct from *Fierasfer homei.*

Our two Samoan specimens were taken from Holothuria, one at Apia, the other at Pago Pago. Another specimen was taken by Mr. W. K. Fisher at Hawaii, from the cloaça of a holothurian (*Stichopus*, n. sp.).

Color in life of a specimen from Apia, translucent with bluish and reddish shades anteriorly. Body with dark cross-shades in adult.

1644. Fierasfer microdon Gilbert. Hawaii.

JORDANICUS Gilbert.

1645. Jordanicus umbratilis (Jordan & Evermann). Hawaii.

This species is known from a few examples taken about lava rocks in Hawaii. One specimen in the Museum of Stanford University, was obtained at Hilo by Mr. H. W. Henshaw from the cavity of a holothurian. From its dark color, this species might be supposed to inhabit crevices of rocks only.

1646. Jordanicus boraborensis (Kaup). Borabora.

Fierasfer boraborensis Kaup, Apodes, 160, 1850, Borabora.

This species has not been recognized by writers subsequent to Kaup.

1647. Jordanicus parvipinnis (Kaup). New Ireland; Hanover; Tahiti.

Fierasfer parvipinnis Kaup, Apodes, 160, pl. 16, fig. 2, 1850, New Ireland. Peters, Berl. Mon. 1876, 844, New Hanover. Günther, Cat., IV, 383, after Kaup. Fowler, Proc. Ac. Nat. Sci. Phila. 1900, 528, Tahiti.

This species was not seen by us.

RHIZOIKETICUS Vaillant.

1648. Rhizoiketicus carolinensis Vaillant. Caroline Is.

Rhizoiketicus carolinensis Vaillant, Comptes Rendus, 1893, 745, Caroline Is.

Family LYCODAPODIDÆ.

SNYDERIDIA Gilbert.

1649. Snyderidia canina Gilbert. Deep seas of Hawaii.

Family BROTULIDÆ.

DINEMATICHTHYS Bleeker.

1650. Dinematichthys iluocœteoides Bleeker. *Tapotopoto.* Samoa; East Indies.

Of this species we have half a dozen specimens from Apia and Pago Pago, where it lives in pools on the reef. These specimens vary widely in the ground color, some being grayish with golden shades, and others bright orange-red. They agree well with Günther's description.

Life colors of a specimen from Apia, brilliant orange-red, the color varying a little with individuals, the head more orange. Another was grayish, the posterior parts golden shaded, the last rays of dorsal, anal, and caudal golden.

BROTULA Cuvier.

1651. **Brotula multicirrata** Vaillant & Sauvage. Hawaii.

(*Brotula townsendi* Fowler.)

1652. **Brotula marginalis** Jenkins. Hawaii.

NEMATOBROTULA Gill.

1653. **Nematobrotula ensiformis** (Günther). Aneiteum; New Hebrides.

Brotula ensiformis Günther, Cat., IV, 372, 1862, **Aneiteum, New Hebrides.**
Nematobrotula ensiformis Gill, Proc. Ac. Nat. Sci. Phila. 1863, 252.

Family ATELEOPIDÆ.

ATELEOPUS Schlegel.

(*Podateles* Boulenger, the name unnecessarily changed on account of the prior name *Atelopus.*)

1654. **Ateleopus plicatellus** Gilbert. Deep seas of Hawaii.

Family GADIDÆ.

ANTIMORA Günther.

1655. **Antimora microlepis** Gilbert. Deep seas of Hawaii.

LÆMONEMA Günther.

1656. **Læmonema rhodochir** Gilbert. Deep seas of Hawaii.

Family MACROURIDÆ.

GADOMUS Regan.

1657. **Gadomus melanopterus** Gilbert. Deep seas of Hawaii.

1658. **Gadomus bowersi** Gilbert. Deep seas of Hawaii.

MELANOBRANCHUS Regan.

1659. **Melanobranchus micronemus** Gilbert. Deep seas of Hawaii.

CHALINURA Goode & Beane.

1660. **Chalinura ctenomelas** Gilbert & Cramer. Deep seas of Hawaii.

OPTONURUS Günther.

1661. **Optonurus atherodon** Gilbert & Cramer. Deep seas of Hawaii.

HYMENOCEPHALUS Giglioli.

1662. **Hymenocephalus antræus** Gilbert & Cramer. Deep seas of Hawaii.

1663. **Hymenocephalus striatulus** Gilbert. Deep seas of Hawaii.

1664. **Hymenocephalus aterrimus** Gilbert. Deep seas of Hawaii.

MACROURUS Bloch.

1665. **Macrourus ectenes** Gilbert & Cramer. Deep seas of Hawaii.

1666. **Macrourus propinquus** Gilbert & Cramer. Deep seas of Hawaii.

1667. **Macrourus holocentrus** Gilbert & Cramer. Deep seas of Hawaii.

1668. **Macrourus gibber** Gilbert & Cramer. Deep seas of Hawaii.

1669. **Macrourus burragei** Gilbert. Deep seas of Hawaii.

1670. **Macrourus obliquatus** Gilbert. Deep seas of Hawaii.

1671. **Macrourus habenatus** Gilbert. Deep seas of Hawaii.

1672. **Macrourus longicirrhus** Gilbert. Deep seas of Hawaii.

CŒLORHYNCHUS Giorna.

1673. **Cœlorhynchus gladius** Gilbert & Cramer. Deep seas of Hawaii.

1674. **Cœlorhynchus aratrum** Gilbert. Deep seas of Hawaii.

1675. **Cœlorhynchus doryssus** Gilbert. Deep seas of Hawaii.

MATÆOCEPHALUS Berg.

(*Cœlocephalus* Gilbert & Cramer, not of Agassiz.)

1676. **Matæocephalus acipenserinus** (Gilbert & Cramer). Deep seas of Hawaii.

MALACOCEPHALUS Günther.

1677. **Malacocephalus hawaiiensis** Gilbert & Cramer. Deep seas of Hawaii.

TRACHONURUS Günther.

1678. **Trachonurus sentipellis** (Gilbert & Cramer). Deep seas of Hawaii.

Family LOPHIIDÆ.

LOPHIOMUS Gill.

1679. **Lophiomus miacanthus** Gilbert. Deep seas of Hawaii.

1680. **Lophiomus naresi** Günther. Admiralty Is.; New Guinea.

Lophius naresi Günther, Challenger Fishes, 1880, 56.

CHIROLOPHIUS Regan.

1681. **Chirolophius moseleyi** Regan. Admiralty Is.

Chirolophius moseleyi Regan, Ann. Mag. Nat. Hist. 1900, 280.

Family CERATIIDÆ.

CHAUNAX Lowe.

1682. **Chaunax umbrinus** Gilbert. Deep seas of Hawaii.

MIOPSARAS Gilbert.

1683. **Miopsaras myops** Gilbert. Deep seas of Hawaii.

Family ANTENNARIIDÆ.

ANTENNARIUS (Commerson) Lacépède. (*Histrio* Fischer.)

1684. **Antennarius commersoni** (Lacépède). Hawaii; Raiatea; Borabora; Tahiti; Shortland I. (Seale); East Indies.

1685. **Antennarius niger** (Garrett). Hawaii.

Chironectes niger Garrett, Proc. Cal. Ac. Sci. 1864, 107, **Honolulu.**

1686. **Antennarius leprosus** Eydoux & Souleyet. Hawaii.

1687. **Antennarius rubrofuscus** Garrett. Hawaii.

1688. **Antennarius sandwichensis** Bennett. Hawaii.

(?*Antennarius horridus*, Bleeker, East Indies.)

1689. **Antennarius laysanius** Jordan & Snyder. Laysan.

1690. **Antennarius hispidus** (Bloch & Schneider). Misol (Günther); Raiatea (Seale); East Indies.

1691. **Antennarius striatus** Shaw. Tahiti; Solomon Is. (Günther, Fische der Südsee, 162, taf. 99, fig. B); East Indies.

1692. **Antennarius duescus** Snyder. Hawaii.

1693. **Antennarius nexilis** Snyder. Hawaii.

1694. **Antennarius dorehensis** Bleeker. New Guinea.

1695. **Antennarius nummifer** (Cuvier). Samoa and Raiatea (Günther; perhaps *Antennarius drombus*); East Indies.

This species seems to be very close to *Antennarius drombus*, differing perhaps in having the dusky shade below the soft dorsal intensified as a black ocellus. The specimens from Samoa and Raiatea, noted by Dr. Günther, probably belong to *Antennarius drombus*, if, indeed, the 2 species are distinct.

Antennarius coccineus (Lesson, Voy. Coquille, 143, pl. 16, fig. 1, 1830), from Mauritius and the East Indies, differs from *Antennarius nummifer* chiefly in the red color. It is equally near *Antennarius drombus*. It is not unlikely that *Antennarius coccineus* is identical with *Antennarius nummifer*, and that the species is not found in Polynesia, where it is replaced by *Antennarius drombus*.

1696. **Antennarius drombus** Jordan & Evermann. Hawaii; Samoa.

This small, dull-colored species is known from 2 specimens from Hilo, Hawaii, and from 1 taken by us at Samoa. None of the other species was obtained by us in Samoa.

In *Antennarius drombus* the dorsal filament or bait is short, and the last ray of dorsal and anal is adnate to the body. *Antennarius coccineus*, as figured by Bleeker, may be this species, but the type figured by Quoy & Gaimard must be something else.

In life our single Samoan specimen was dull mottled olive-green with blackish markings, and a few dull orange blotches, irregular and diffuse; no red. When captured, this fish swells its body like a *Tetraodon*.

1697. **Antennarius bigibbus** Lacépède. Hawaii.

PTEROPHRYNE Gill.

1698. **Pterophryne histrio** (Linnæus). New Guinea (Bleeker); East Indies.

Family OGCOCEPHALIDÆ.

MALTHOPSIS Alcock.

1699. **Malthopsis mitrigera** Gilbert & Cramer. Deep seas of Hawaii.

1700. **Malthopsis jordani** Gilbert. Deep seas of Hawaii.

HALIEUTÆA Cuvier.

1701. Halieutæa retifera Gilbert. Deep seas of Hawaii.

DIBRANCHUS Peters.

1702. Dibranchus erythrinus Gilbert. Deep seas of Hawaii.

1703. Dibranchus stellulatus Gilbert. Deep seas of Hawaii.

TETRABRACHIUM Günther.

1704. Tetrabrachium ocellatum Günther. New Guinea.

Tetrabrachium ocellatum Günther, Challenger Fishes, 41, 1880.

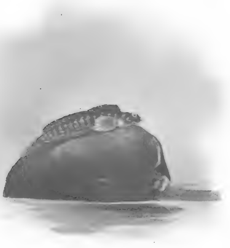


Fig. 131.—*Alticus saliens* (Forster).

VERNACULAR NAMES OF FISHES HEARD IN HAWAII AND SAMOA.

In the following table, the vernacular names heard by us in Hawaii and Samoa are brought together for purposes of comparison. The Samoan names as given here were obtained by Professors Jordan and Kellogg in Apia and Pago Pago, most of them from the fishermen Taua and Vaiula. The authors are indebted to Mr. Edwin Gurr, of Pago Pago, for a preliminary correction of these names, and to Mr. W. E. Safford for a very much more careful revision of their spelling and meaning, and for the following glossary of the principal nouns and adjectives in the list. It may be noted that *h* in Hawaiian is replaced by *s* or *f* in Samoan, and that *k* in Hawaiian is replaced by *t* in Samoan. Intercourse between the two groups of islands has in recent years tended to corrupt the Samoan pronunciation, and we often hear in Apia, *kiñkiñ* and the like, when *tiñtiñ* is the correct Samoan form. The Samoan *g* (as in Pago Pago or Ga) is pronounced like *ng*. The vowels are pronounced as in Italian, *ou* not being a diphthong.

From Lorin Andrews's Hawaiian-English Dictionary we copy the following table, showing the shifting of the consonants in the Polynesian languages:

Fakaofo.	Samoa.	Tonga.	New Zealand.	Rarotonga.	Tahiti.	Hawaii.	Marquesas.
F	F	F	W or H	Wanting	F or H	H	F or H
K	'	K	K	K	'	'	K
L	L	L	R	R	R	L	Wanting
M	M	M	M	M	M	M	M
N	N	N	N	N	N	N	N
NG	NG (G)	NG	NG	NG	Wanting	M	N or NG
P	P	P or B	P	P	P	P	P
S	S	H	H	Wanting	H	H	H
T	T	T	T	T	T	K	T
V	V	V	W	V	V	W	V

NAMES OF SPECIES.	HAWAII.	SAMOA.
Shark	Mano	Malie, Tanifa.
Carcharias melanopterus		Malie alamata.
Sphyrna zygæna	Mano kihikihi	Mata-i-taliga.
Himantura fai		Fai.
Stoasodon narinari	Hihimanu	
Mobula japonica	Hihilua	
Elops saurus	Awa	
Albula vulpes	Oio	
Chanos chanos	Awa awa, Puawa, Awa kalamoko.	
Etrumeus micropus	Omaka, Makiawa	
Harengula commersoni		Pelupelu.
Sardinella sirm		Pelupelu, I'a moana.
Stolephorus delicatulus		Nefu.
Anchovia	Naua	Nefu.
Plotosus anguillaris		Apoa.
Trachinocephalus myops	Kawalea	
Synodus varius	Ulae	
Saurida gracilis	Ulae	
Anguilla	Paka	Tuna.
Anguilla mauritiana		Tuna gatala, Tuna tafa'i-lautalo.

Vernacular names of fishes heard in Hawaii and Samoa—Continued.

Names of Species.	Hawaii.	Samoa.
Anguilla megastoma		Tuna mea.
Leptocephalus marginatus	Puhi aha	Pusi solasulu.
Leiuranus semicinatus		'Ata'ata uli.
Muræna kailuæ	Puhi kauila; puhi oa	
Gymnothorax	Puhi	Pusi.
Gymnothorax flavomarginatus		Pusi gatala.
Gymnothorax pictus	Puhi wela	Pusi gatala.
Gymnothorax undulatus	Puhi laumilo	Pusi pulepule.
Gymnothorax stellatus		Pusi pulepule.
Gymnothorax javanicus		Pusi maoa'e.
Echidna nebulosa	Puhi kapa	
Echidna leihala	Puhi leihala	Pusi 'ai'aiuga.
Scuticaria tigrina		Pusi solasulu.
Tylosurus giganteus	Aha'aha, Auau	A'u.
Tylosurus leiuroides		A'u.
Athlennes hians	Aha-aha	
Belone platyura		Ise.
Hemiramphus affinis		Ise lai.
Hemiramphus depauperatus	Ihe, Me'e-me'e, Puihi	
Euleptorhamphus longirostris	Iheihi	
Parexocœtus brachypterus	Puhiki'i	
Zenarchopterus vaisiganis		Taoto.
Cypsilurus		Malolo.
Cypsilurus simus	Malolo	
Aulostomus valentini	Nunu	Taotito.
Microphis brachyurus		Taotao.
Atherina uisila		Uisila.
Liza melinoptera		Afa, Fue'afa.
Liza troscheli		Aua.
Liza cæruleomaculata		Anae, 'Aua'analagi.
Chænomugil chaptali	U'ou'oa (Wau wau)	
Mugil cephalus	Ama ama, Anae	
Sphyræna helleri	Kaku	
Sphyræna commersoni	Welea	
Sphyræna obtusata		Sapatu.
Polydactylus plebeius		Umiumia.
Polydactylus sexfilis	Moi	
Lampris regia	Laukipala, Lauipala	
Holocentrus	Aleihi	Malau.
Holotrachys lima		Malau mutu, Mutu.
Myripristis	U'u	Malau.
Myripristis pralinius		Malau mamo, Mamo.
Myripristis microphthalmus		Malau mataputa, Malau tea.
Myripristis sanguineus		Malau ula, Segasega.
Myripristis chryseres	Pau'u	
Myripristis adustus		Malau suo.
Myripristis murdjan	U'u	Manifinifi.
Holocentrus spinifer		Malau toa.
Holocentrus caudimaculatus		Tamalau mumu, Tameno mumu.
Holocentrus violaceus		Malau tifi, Malau pāuli.
Holocentrus diadema		Malau tusitusi, Malau pāuli, Malau tui.
Holocentrus punctatissimus		Malau faiumu.
Holocentrus sammara		Malau peapea.
Lemnisoma thyrsitoides	Hauliuli	
Scomber loo		Ga.
Germo germo	Ahi	
Scomberoides sanctipetri	Lai, Papiopio	Lai.
Gymnosarda pelamis	Aku	
Gymnosarda alleterata	Kawa kawa, Ahua	
Acanthocybium solandri	Ono	
Seriola purpurescens	Puakahala, Kahala	

Vernacular names of fishes heard in Hawaii and Samoa—Continued.

NAMES OF SPECIES.	HAWAII.	SAMOA.
Decapterus sanctæ-helenæ	Opelu	
Megalaspis cordyla		Atualo.
Trachurops crumenophthalma	Akule	Atule.
Caranx forsteri	Omilu, Ulua, Papiopio, Pa'u pa'u.	Ulua.
Caranx melampygus		Malauli.
Caranx affinis	Amuka, Puakahala	
Caranx sexfasciatus		Lupo.
Caranx ignobilis		Lupo.
Caranx ferdau		Lupo.
Caranx speciosus	Paopao, Ulua pau'u	
Caranx plumbeus		Lupo ta, Lupo, Lalafutu, Alâlafutu.
Alectis ciliaris	Ulua kihikihi	
Trachinotus ovatus		Alâlafutu.
Pempheris oualensis		Manifi, Fo a'ao.
Pempheris vanicolensis		Pula.
Monodactylus argenteus		Toto.
Coryphæna hippurus	Mahihi, Mahimahi	
Kuhlia malo	Aholehole	
Kuhlia rupestris		Sesele.
Kuhlia marginata		Salele.
Kuhlia tæniura		Safole.
Amia	Upapalu	Fo.
Apogonichthys marmoratus		Fo mumu.
Paramia macrodon		Tuganini.
Paramia quinquelineata		Mata uliuli.
Ambassis lafa		Lafa.
Ambassis vaivasensis		Lafa.
Chorististium susumi		Susu umi.
Anyperodon leucogrammicus		Gatala aleva.
Variola louti		I'a manaia.
Epinephelus dæmeli		'Uo'uo.
Epinephelus merra		Gatala, 'Ata'ata pulepule.
Epinephelus quernus	Hapu'u pu'u	
Cephalopholis urodelus		Mata'ili.
Cephalopholis argus		Gatala moana, Gatala uli, Vaiania.
Cephalopholis leopardus		Gatala uli.
Priacanthus cruentatus	Aweoweo	Mata-pula.
Priacanthus alalaua	Alalaua	
Lutianus gibbus		Ti'ava, Mala'i, Mala'i pa'epa'e.
Lutianus marginatus		Lanue, Nanue, Taiva, Tagau, Tamala.
Lutianus rivulatus		Uiui, Nanue.
Lutianus argentimaculatus		'A'a, Nanue.
Lutianus monostigma		Taiva uliuli, Feloitega, Vava sui.
Lutianus bohar		Mumea.
Aprion virescens	Uku	
Apsilus microdon	Ukikiki	
Etelis marshi	Ulaula	
Etelis evurus	Koi	
Bowersia violescens	Opakapaka	
Bowersia ulaula	Ulaula koa'e	
Lethrinus ramak		Mata fe'u, Magauli.
Lethrinus harak		Mata 'ele'ele.
Terapon jarbua		'Ava'ava.
Lethrinella miniata		Filoa 'ava.
Monotaxis grandoculis	Mu, Mamamu	Mumu moaga, Loalia (Rarotongan word).
Gnathodentex aurolineatus		Tolai.
Scolopsis trilineata		Taiva tusi

Vernacular names of fishes heard in Hawaii and Samoa—Continued.

NAMES OF SPECIES.	HAWAII.	SAMOA.
Euelatichthys crassispinus		Misi misi.
Plectorhynchus diagramma		'Ava'ava moana.
Plectorhynchus chætodonoides		I'a mai moana.
Xystæma gigas		Matu loa.
Xystæma argyreum		Matu.
Kyphosus waigiensis		Matu mutu, Umue.
Kyphosus fuscus	Mamamo	
Mulloides auriflamma	Weke	Vete, Ula oa.
Mulloides samoensis	Weke	I'a sina, Afolu.
Pseudupeneus moana		Moaga, Moana, Maga, Moana faiava.
Pseudupeneus multifasciatus	Moana	
Pseudupeneus bifasciatus	Moana	Matalau, Uliuli, Maga.
Pseudupeneus chryserydros		Matalau.
Pseudupeneus indicus		Ta'uleia, Lailui.
Pseudupeneus barberinus		Ta'uleia.
Oceanops latovittata		Gatasami.
Malacanthus parvipinnis	Maka'a	
Upeneus arge	Weke pueo, Weke pahulu	
Upeneus vittatus		Vete.
Mulloides flammeus	Weke ula	
Cirrhitus marmoratus	O'opukai'a, po'opa'a	Potati.
Paracirrhites forsteri	Pilikoa, Hilupilikoa	
Paracirrhites arcatus	Pilikoa	
Paracirrhites cinctus	Pilikoa, Oopukahaihai, po'opa'a	
Cheilodactylus vittatus	Kikakapu	
Dascyllus aruanus		Mamo.
Dascyllus albisella	Pa'apa'a	
Pomacentrus albofasciatus		Ulavāpua.
Pomacentrus pavo		Taupou.
Pomacentrus melanopterus		I'u sina, Tu'u'u.
Pomacentrus jenkinsi	Kole	
Pomacentrus vaiuli		Vaiuli.
Pomacentrus nigricans		Tu'u'u.
Pomacentrus lividus		Tu'u'u sue uli, I'u sina.
Abudefduf cœlestinus		Fili mana.
Abudefduf sordidus		Ulavāpua.
Abudefduf septemfasciatus		Alala saga; Mutu.
Abudefduf dicki		Tu'u'u.
Abudefduf abdominalis	Mamama	
Abudefduf lacrymatus		I'u samasama.
Abudefduf leucopomus		Tu'u'u.
Abudefduf uniocellatus		Taupou.
Abudefduf taupou		Vaiuli sama, Taupou.
Abudefduf metallicus		Pipi.
Chromis cæruleus		Teatea, Mamo, I'a lanu-moana.
Chromis analis		I'a lanu-moana.
Epibulus insidiator		Lapega, Gutu-ume.
Labrichthys cyanotænia		Sugale uliuli.
Anampses	Hilu	Sugale.
Anampses cæruleopunctatus		Sugale lupe.
Anampses cuvieri	Opule	
Hemigymnus melapterus		Paumutu, Alatı moana, Sugale aloa, Sugale uli, Tagitagi.
Lepidaplois albotæniatus	A' awa	
Lepidaplois strophodes	A' awa	
Lepidaplois modestus	A' awa	
Halichœres centiquadrus		Ifigi.
Halichœres lao	Lao	
Halichœres ornatissimus	Ohua pa'awela	
Halichœres dædalma		Fataga loa.
Thalassoma	Hinalea	Sugale.

Vernacular names of fishes heard in Hawaii and Samoa—Continued.

NAMES OF SPECIES.	HAWAII.	SAMOA.
Thalassoma purpureum	Opule, Olale, Palaea, Hou, Awela.	
Thalassoma fuscum	Awela, Olale	Sugale.
Thalassoma duperreyi	Hinalea, Lauli, A'laihi	
Thalassoma dorsale		Sugale sei, Sugale fa'a 'ele'ele, Sugale pulepule.
Thalassoma ballieui	Hinalea huahine	
Coris schauinslandi	Hilu mele mele	
Julis lepomis	Hilu lawili, Uhu	
Julis gaimardi	Hinalea lolo	
Julis pulcherrima	Hinalea lolo	
Novaculichthys taeniurus		Molemole.
Macropharyngodon geoffroyi	Hinalea akilolo	
Gomphosus tricolor	Akilolo	Sugale.
Cheilio inermis	Kupou pou	Masamie, Moai.
Cheilinus fasciatus		Lalafi pulepule.
Cheilinus digrammus		Sugale, Lalafi.
Cheilinus hexagonatus	Po'ou	
Cheilinus trilobatus		Lalafi, Sugale matamumu.
Thalliurus chlorurus		Sugale gasufi.
Pseudocheilinus hexataenia		I'a tusitusi.
Calotomus sandwichensis	Uhu	
Callyodon prasiognathus		Amasapupema.
Callyodon maoricus		Moalefuga.
Callyodon pyrrhurus		Fuga mumu.
Callyodon bennetti		Amasapupema.
Callyodon ruberrimus		Fuga ulapo.
Callyodon erythrodon		Fuga 'avasai.
Callyodon balinensis		Fuga pa'i, Fuga pa'ipa'i, Fuga mea.
Callyodon oviceps		Fuga uli.
Callyodon zonularis		Fuga mea.
Callyodon bataviensis		Tapoli, Laea mumu.
Callyodon formosus	Lauia	
Callyodon abacurus		Fuga meamea.
Callyodon gilberti	Panuhunuhu	
Callyodon latax		Laea pulepule, Laea mumu.
Callyodon paluca	Palukaluka	
Callyodon jordani		Galo, Laea galo.
Callyodon ahula	Uhu uliuli, Panuhunuhu	
Callyodon ultramarinus		Fuga gatu-moana.
Callyodon lazulinus		Fugausi.
Megaprotodon trifascialis		Mutu uli.
Chætodon setifer	Kikakapu	Si'u, Tifitifi sama.
Chætodon citrinellus		Tifitifi uli, Tifitifi laufi, Manini.
Chætodon vagabundus		Tifitifi mata-ume, Samasama.
Chætodon reticulatus		Tifitifi a'o, Matagi pulepule.
Chætodon trifasciatus		Tifitifi tala.
Chætodon lunula		Tifitifi laumea.
Chætodon unimaculatus	Kikakapu	Tifitifi pulepule, Tifitifi samasama.
Chætodon melannotus		Tifitifi pulepule pa'ipa'i.
Chætodon ornatissimus	Kikakapu	Tifitifi a'au.
Chætodon mertensi		Tifitifi pa'ipa'i.
Chætodon pelewensis		Tifitifi i'u sama.
Chætodon ephippium		Tifitifi ila, Tifitifi taiona, Tifitifi tusi.
Holacanthus		Alamu.
Holacanthus diacanthus		Aimeo, Alamu.
Holacanthus bicolor		Ulapua.
Holacanthus flavissimus		Lega, Aimeo.
Holacanthus bispinosus		Tu'u'u pulepule mumu.
Heniochus acuminatus		Laulaufau.

Vernacular names of fishes heard in Hawaii and Samoa—Continued.

NAMES OF SPECIES.	HAWAII.	SAMOA.
Zanclus canescens	Kihikihi, Loulu.	Tifitifi, Galafa.
Platax orbicularis		Pe'ape'a uli.
Hepatus matoides	Walu.	Umelei.
Hepatus lineatus		Alogo.
Hepatus aliala		Loata, Alamea samasama.
Hepatus triostegus		Manifi.
Hepatus sandwichensis	Manini	
Hepatus dussumieri	Pualu	
Hepatus atramentatus	Maikoiko	
Hepatus olivaceus	Nae-nae	
Hepatus nigricans		I'u sina, Uliuli maia.
Hepatus achilles		Pone i'u mumu.
Hepatus aquilinus		Palagi samasama.
Hepatus elongatus	Maii'i	Unavau.
Hepatus guttatus	Api	Moana, Aau.
Ctenochætus striatus	Kolo	Palagi, Ponepone, Aau.
Zebrasoma rhombeum		Ali palagi, Iliu.
Zebrasoma flavescens	Laipala	Samasama.
Zebrasoma veliferum	Api, Maneoneo	Lupo.
Zebrasoma rostratum		Ali.
Acanthurus lituratus	Pakala kala, Kala	Ili'ilia, Umelei, Ume.
Acanthurus unicornis	Kala	Ili'ilia segi, Ume, Umelei.
Siganus marmoratus		Lo pa'u'ulu.
Siganus punctatus		Lo 'ele'ele.
Balistes	Humuhumu, Ui'ui	Sumu.
Balistes chrysopterus		Sumu pa'epa'e.
Balistes vidua		Sumu i'u mumu, Sumu pa'epa'e mumu.
Balistes flavomarginatus		Sumu laolao.
Balistapus undulatus		Sumu uli.
Balistapus rectangulus	Pu'a humuhumu, Humuhumu nukunuku apua'a.	Sumu pulepule.
Balistapus aculeatus		Sumu uliuli.
Amanses scopas		Sisitui.
Cantherines sandwichensis	O'ililepa, Ohua	Aimeo.
Monocanthus melanocephalus		Moloasi, Pa'u-mea.
Monocanthus spilosomus	O'e o'e, Oili	
Oxymonacanthus longirostris		Aleva.
Osbeckia scripta	O'ililepa, Ohua	
Alutera monoceros	Loulu	
Lactoria cornuta		Moamoa.
Ostracion tuberculatum		Moamoa uli.
Ostracion sebae	Moa	Moamoa samasama.
Ostracion oahuensis	Moamoa wa'a	
Ostracion lentiginosum		Moamoa uliuli.
Lactoria galeodon	Makukana	
Tetraodon hispidus	O'opuhue Keke, Makimaki	Sue.
Tetraodon nigropunctatus	Makimaki	Sue.
Canthigaster solandri		Sue mimi.
Canthigaster epilamprus	Pu'u olai	
Chilomycterus affinis	O'opuhue	
Diodon hystrix		Tauta.
Ranzania makua	Apahu, Makua	
Sebastopsis guamensis		La'otale.
Sebastopistes laotale		La'otale.
Scorpaenopsis gibbosa	Nohu, Omakaha	Nofu.
Synanceja verrucosa		Nofu.
Dendrochirus sausaulele		Sausaulele.
Cephalacanthus orientalis	Lolóau, Pina'o	
Caracanthus maculatus		Tu'u'u.
Parapercis tetracanthus		Ta'oto.

Vernacular names of fishes heard in Hawaii and Samoa—Continued.

NAMES OF SPECIES.	HAWAII.	SAMOA.
Leptecheneis naucrates		Talitaliuli.
Synchiropus lili		Lili.
Periophthalmus barbarus		Mano'o, Talae.
Hypseleotris guntheri		Malu vai.
Eleotris fusca	O'opu, Okuhekuhe	Pa'ofu.
Valenciennea violifera		Ta'oto.
Zonogobius semidoliatus		Mano'o.
Vailima stevensoni		Pa'ofu.
Awaous ocellaris		Mano'o, I'a pala.
Awaous genivittatus		Teli.
Awaous stamineus	O'opu	
Eviota prasites		Lili.
Mapo fuscus		Pa'ofu.
Pseudogobiodon citrinus		Ulitui.
Salarias	Poa'o	Mano'o.
Exallias brevis	Poa'o kauila	Mano'o gatala.
Alticus		Mano'o.
Alticus striatus		Mano'o a'au.
Platophrys pantherinus	Paki'i	Ali.
Platophrys mancus		Ali.
Brotula marginalis	Puhi palamoana	
Dinematichthys iluocœteoides		Tapotopoto.

GLOSSARY OF PRINCIPAL WORDS COMPOSING NATIVE NAMES OF SAMOAN FISHES.

By W. E. Safford.

The following vocabulary, based chiefly on notes taken in Samoa during the months of February, March, April, and May, 1888, was obtained from native fishermen, all of whom showed the greatest interest in telling me of the fishes of the reef, the ocean, and the stream, distinguishing those which were best for food from those which were unwholesome or poisonous, and warning me against those armed with stinging spines and those lurking in holes in the coral which inflict severe wounds with their sharp teeth. One of the most interesting lists I secured from an old native who was fishing for sharks from a canoe lying under our stern at Leone Bay. This man would attract the attention of a shark by shaking in the water a number of half shells of cocoanuts strung loosely on a stick, rim to rim. The shark would approach to within a few fathoms of the canoe to find out the cause of the commotion; then the native would throw out a bait (*māūnu*), consisting of a fish's head attached to a string, and draw it gently toward the canoe, the shark following. When the shark was within reach, the fisherman would seize a heavy club he had in readiness and strike the shark a violent blow on the head to stun it, then slip a noose (*maea*) over its head and, holding it alongside the canoe, dispatch it with a knife. This was to me an example of the most primitive method of fishing. The rattle he called *tui-ipu* (string of cups); the shark was one of the kind called *malie.* The fisherman told me of a larger kind, called *tanifa*, which was known to attack men while swimming, and as he found an interested listener he followed his account with a list of the principal fishes of Samoa. The names I wrote down at once, later correcting the orthography with the aid of Dr. George Pratt's excellent dictionary of the Samoan language. Afterwards I supplemented my list by additional information obtained at native feasts and from fishermen returning from the reefs with their spears and nets and from their exciting chase for bonitos in their swift canoes provided with poles and trolling lines. Of course I could only record the native names, without attempting to do more than determine the genera or families of the most conspicuous kinds. The present work of Doctor Jordan makes it possible for the first time to identify the species of nearly all of the fishes in my list.

In this list there are certain names marked with an interrogation point. These I was unable to check with my list or to explain in a satisfactory manner. Some of the names of fishes are primitive, like *atu*, *pusi*, *fai*, and are widespread throughout Polynesia; others have a definite significance, such as *ī'a sina*, white fish; *ī'u-samasama*, yellow-tail; and others, like the long-beaked *aleva*, take their names from those of birds or other natural objects. I have included also the principal adjectives, verbs, and nouns from which compound names of fishes have been formed.

'a'a, *n.* A snapper, *Lutianus argentimaculatus.*

aau, *n.* A name applied to two lancet-fishes, *Hepatus guttatus* and *Ctenochaetus striatus.* See *au*, a sharp fish spine, a needle.

a'au, *n.* The coral reef; *akau* (New Zealand), the border of land near the sea.

afa, *n.* A cord, or sinnet, braided from cocoanut-fiber, a string.

afa'afa, *n.* Name applied to a thread-fin, *Polydactylus plebeius*, a fish with its pectoral fins modified into string-like organs of touch.

afo, *n.* A fishing line. *Aho* (Hawaii and Tahiti), a line or cord.

afolu, *n.* Name applied to a surmullet, *Mulloides samoensis*, a fish with thread-like barbels growing from the throat.

ago, *v.* To mark a pattern for tattooing; to mark with charcoal.

aimeo, *n.* Name applied to file-fishes of the genera *Holacanthus* and *Cantherines.*

alala, *n.* Plates or scales of tortoise-shell.

alala-saga, *n.* Name applied to a demoiselle-fish (*Abudefduf septemfasciatus*) with tortoise-shell-like markings.

alālafutu, *n.* Name applied to a pompano, *Trachinotus ovatus*, and to *Caranx plumbeus*, fish having the first rays of the dorsal fin more or less filamentous.

alamu (alamea?), *n.* Name applied to species of *Holacanthus.*

alamea, *n.* A many-rayed sea-urchin.

alamea, *n.* A surgeon-fish, *Hepatus aliala.*

alati-moana (?), *n.* *Hemigymnus melapterus.*

aleva, *n.* A little file-fish with beak-like snout, *Oxymonacanthus longirostris.*

aleva, *n.* Name of a bird (*Eudynamis taitensis*).

ali, *n.* A flounder (*Platophrys*); name applied also to a flat fish (*Zebrasoma*) with a superficial resemblance to a flounder.

ali-palagi, *n.* *Zebrasoma rhombeum.*

aloalo, *n.* The lagoon between the beach and the reef.

alogo, *n.* A beautifully marked surgeon-fish, *Hepatus lineatus.*

alomātū, *adj.* Partially dry.

'analagi, 'ana'analagi, *n.* A mullet-like, spotted fish, *Liza cæruleomaculata.*

anaana (Tahiti), *adj.* Beaming, shining; *kanakana* (Paumutu), bright, radiant; *kana* (New Zealand), the eyeballs.

'anae, *n.* The name of a fish (*liza* sp.); *kanae* (New Zealand), the gray mullet; *anae* (Tahiti) a mullet; *anae* (Hawaii), a mullet.

anefe, *n.* Name applied to young of *lo* (*Siganus* sp.).

'ao, *adj.* Small, slender.

apoa, *n.* An eel-like fish with stinging dorsal spine, *Plotosus anguillaris.*

apo (Hawaii), *v.* To catch, to hook into; *apoapo* (Samoa), to poise a spear.

'ata'ata, *n.* A name applied to several fishes of the genera *Epinephelus*, *Cephalopholis*, and *Leiurus*.

ata'ata (Hawaii), *n.* The falling off of the scarf skin after drinking awa; *akaa* (Hawaii), not cohering; *ataa* (Tahiti), split up into patches or areoles not adhering. Possibly the name applied to the sea-basses or groupers on account of their spotted coloration.

'ata'ata pulepule, *n.* A sea-bass, *Epinephelus merra.*

'ata'ata uli, *n.* Dark-colored *'ata'ata.*

atu, *n.* A bonito (*Gymnosarda pelamis*). *Aku* (Hawaii), a bonito.

atualo, *n.* A bonito, *Megalaspis cordyla.*

atule, *n.* The "goggle-eyed jack," or horse mackerel, *Trachurops crumenophthalma.* *Akule* (Hawaii); *aturere* (New Zealand), a highly prized fish.

atunga-loloa, *n.* "Long-fin," a crevallé, *Caranx hasselti.*

atunga, *n.* The fin of a fish.

au, *n.* A fish-spine, a needle.

a'u, *n.* Name applied to hound-fishes, *Tylosurus giganteus*, etc.

aua, *n.* Name applied to a young *'anae*, *Liza troscheli.*

ava, *n.* The name of a very scaly fish.

'ava 'ava, *n.* *Terapon jarbua.* *Kawa* (New Zealand), name of a traditional being which hung like a veil upon the forehead of the eel-god, Tuna.

'ava 'ava moana, *n.* *Plectorhynchus diagramma.*

'avasai, *adj.* Perhaps *'avasia*, burnt by the sun.

'ele'ele, *n.* *Siganus punctatus.* *'Ele* (Samoa) rust, red earth; *ereere* (Tahiti), black, dark, also blue; *eleele* (Hawaii) dark-colored-black, blue.

fa'a moana, *adj.* Pelagic, a name applied to fish found in schools far out from shore. *Moana* (Samoa), the ocean; *moana* (Hawaii, New Zealand), the ocean.

fai, *n.* A sting-ray, *Himantura fai.* *Whai* (New Zealand), a sting-ray; *fai* (Tahiti), a sting-ray; *vai* (Fiji), a sting-ray.

faiumu, *v.* To cook an oven of food.

fataga loa, *n.* *Halichœres dædalma.*

felo, *adj.* Light yellow.

fili, *n.* Sinnet, braided cocoanut fiber; *fili mama*, a ring braided of cocoanut fiber.

filoa, *n.* *Lethrinella miniata.*

fo, *n.* Name applied to fishes of the genus *Amia* and related genera.

fo mūmū, *n.* *Apogonichthys marmoratus.*

foa'ao, *n.* *Pempheris oualensis.*

fui, *n.* A collection or cluster.

fuifui-atu, *n.* A school of bonito.

fuga, *n.* Name applied to parrot-fishes (Callyodontidæ).

fuga 'avasai, *n.* *Callyodon erythrodon.*

fuga galu-moana, *n.* *Callyodon ultramarinus.*

fuga mea, *n.* *Callyodon balinensis; C. zonularis.*

fuga meamea, *n.* *Callyodon obscurus.*

fuga mūmū, *n.* *Callyodon pyrrhurus.*

fuga pa'ipa'i, *n.* *Callyondon balinensis; C. oviceps.*

fuga ulapo, *n.* *Callyodon ruberrimus.*

fuga usi, *n.* *Callyodon oviceps.*

ga, *n.* A mackerel, *Scomber loo.*

galo, *n.* A full-grown *usiusi.*

galo, *n.* *Callyodon jordani.*

galu, *n.* Wave. *Galu-tai* (Samoa), wave-of-the-sea; *galu-moana* (Samoa), wave-of-the-ocean; *gagalu*, to be rippled, as the water by a fish swimming near the surface.

galu-moana, *adj.* Mispronunciation of *lanu-moana*, sea-blue.

galafa (?), *n.* *Zanclus canescens.*

gata, *n.* A snake. *Ngata* (Tonga, Fiji), a snake; *ngata* (New Zealand), a snail or slug.

gata-sami, *n.* *Oceanops lativittata.* *Gata-sami* (Samoa), sea-snake; *sami* (Samoa), the sea, salt water. (Perhaps *matasami*, said to mean eye of the sea.)

gatala, *adj.* Name applied to a number of spotted fishes, especially sea-basses of the genera *Epinephelus* and *Cephalopholis.* *Naka* (Hawaii), to split or break open, as the ground in a drought; *nukaka* (Hawaii), full of cracks; *ngatata* (New Zealand), full of cracks, as skin which is chapped.

gatala, *n.* *Epinephelis merra.*

gatala aleva, *n.* *Anyperodon leucogrammicus.*

gatala moana, *n.* *Cephalopholis argus.*

gatala uli, *n.* *Cephalopholis leopardus*; *C. argus.*

gutu-umi, *n.* *Epibulus insidiator.* *Gutu* (Samoa), mouth, snout; *umi*, drawn out, elongated.

i'a, *n.* Fish; the general name in Samoa for all fishes except the bonito. *Ika* (New Zealand, Tonga, Marquesas, Fiji), the general name for fish; *ikan* (Malay); *guihan* (Guam).

i'a lanu-moana, *n.* "Fish color-of-the-ocean," a name applied to *Chromis cæruleus* and *C. analis.*

i'a mai-moana, *n.* A name applied to *Plectorhynchus chætodonoides.*

i'a pala, *n.* *Awaous ocellaris.*

i'a sina, *n.* *Mulloides samoensis.*

i'a tusitusi, *n.* *Pseudocheilinus hexatænia.*

i'a ui, *n.* Name applied to a large eel.

i'a vai, *n.* A name sometimes applied to fresh-water eels.

ifigi (?), *n.* *Halichœres centiquadrus.*

ila, ilaila, *adj.* Spotted, or marked.

'ili, *n.* A rasp or file; a saw.

'ili'ilia, *n.* *Acanthurus lituratus* (juv.); *A. unicornis.*

ili, *n.* A fan.

iliū (ili-i'u), *n.* *Zebrasoma rhombeum.*

inato, *n.* *Kuhlia rupestris.*

ise, *n.* A half-beak (*Hemiramphus*) and *Belone platyura.* *Ihe* (New Zealand), a gar-fish or half-beak; *ihe* (Hawaii, Tahiti), a spear; *ihe* (Marquesas), a fish with a long beak.

i'u, *n.* The tail of a fish; the end of anything. *Hiku* (New Zealand), the tail of a fish or reptile; *iku* (Tonga), the tail of animals; *ikur* (Malay), the tail of animals, the train of a garment; *hiu* (Hawaii), the tail of a fish.

i'u-mumu, *adj.* Red-tailed.

i'u-samasama, *n.* Yellow-tail, *Abudefduf lacrymatus.*

i'u-sina, *n.* White-tail, *Pomacentrus melanopterus.*

lae, *n.* The part between the lip and the chin without hair. *Lae* (Hawaii), any projecting part; the forehead.

laea, *n.* Name applied to several fishes of the genus *Callyodon.*

laea galo, *n.* *Callyodon jordani.*

laea mumu, *n.* *Callyodon bataviensis* and *C. latax.*

laea pulepule, *n.* *Callyodon latax.*

lai, *n.* A mackerel, *Scomberoides sanctipetri.*

lailai (?), *n.* *Pseudipeneus indicus.*

laitiiti, *adj.* Small.

lalafi, *n.* *Cheilinus diagrammus.* *Lafi* (Samoa), to hide away.

lalafi pulepule, *n.* *Cheilinus fasciatus.*

lālāfutu, *n.* *Caranx armatus.*

lanifi, *adj.* Thin. (See *manifi.*)

lanu, *n.* Color.

lanu-moana, *adj.* Sea-color, sky-blue.

laolao, *adj.* Smooth.

laotale, *n.* Fishes with poisonous spines, *Sebastopsis guamensis,* and *Sebastapistes laotale.*

lau, *n.* A leaf. *Lau-taro,* a taro leaf; *lau-ulu,* hair (foliage) of the head.

laulaufau, *n.* *Heniochus permutatus.*

lele, *v.* To fly.

lega, *adj.* Yellow, turmeric.

lega, *n.* A yellow fish, *Holocanthus flavissimus.*

lili, *n.* *Synchiropus lili.*

lo, *n.* Name applied to several fishes of the genus *Siganus.*

lo-mea, *n.* Name applied to young fry of *lo*, *loloa*, and *anefe* (*Siganus* species). In Guam these are caught in great quantities and preserved by the natives, who call them *mañahag.*

lo pa'u'ulu, *n.* *Siganus marmoratus.* *Pa'u-'ulu* signifies "rind of a bread-fruit," which is composed of a number of areoles.

loa, *adj.* Long.

loata, *n.* *Hepatus aliala.*

logouli, *n.* Name applied to the *maomao* when it is changing color to become a *pala'ia.*

loloa, *n.* Name of a fish (*Siganus*).

lese pule (?), *n.* *Cæsio cærulaureus.*

lupa, *n.* *Zebrasoma veliferum.*

lupe, *adj.* Sometimes incorrectly used for *pule* (spotted).

lupo, *n.* *Caranx ignobilis; C. sexfasciatus.*

lupo tā, *n.* A large lupo.

mago, *n.* Name for one kind of shark. *Mango* (New Zealand), *mano* (Hawaii), *mao* (Tahiti), names for sharks.

mai, *prep.* From; *mai-moana* (Samoa), from the ocean, pelagic.

mala'i, *n.* A snapper (*Lutianus* sp.).

mala'i pa'epa'e, *n.* *Lutianus gibbus.*

malau, *n.* Name applied to squirrel-fishes (*Myripristis* and *Holocentrus*).

malau faiumu, *n.* A rose-colored fish with silver lines, *Holocentrus punctatissimusk*, called also *malau matapua'a.*

malau mataputa, *n.* A squirrel-fish, *Myripristis microphthalmus*, called also *malau tea.*

malau tea, *n.* A squirrel-fish, *Myripristis microphthalmus.*

malau vai, *n.* A fish entering fresh-water streams, *Hypseleotris guntheri.*

malauli, *n.* A cavally, *Caranx melampygus.*

malie, *n.* General name applied to sharks.

malie alamata, *n.* *Carcharias melanopterus.* *Malie alo* (belly-shark), name applied to a shark found inside the lagoon; *malie tua* (back shark), another kind found outside the lagoon.

mālolo, *n.* General name for flying-fishes (*Cypsilurus* sp.). *Malolo* (Hawaii), name for flying-fishes (*Parexocœtus*, etc.).

mamo, *n.* Name applied to *Chromis cæruleus*, *Myripristis pralinius* and *Dascyllus aruanus.* They feed on coral reefs.

mānaia, *adj.* Handsome; a dandy, or beau.

manifi, manifinifi, *adj.* Thin. A name applied to *Hepatus triostegus*, *Holocentrus spinifer*, *Pempheris oualensis*, and *Pseudupeneus* sp. *Nihinihi* (Hawaii), anything standing on the edge, a sharp ridge.

manini, *n.* The name of a fish, *Hepatus triostegus.*

mano'o, *n.* Name applied to blennies, or to goby-like fishes frequenting stones along the edge of the sea.

mano'o, *n.* *Awaous ocellaris; Alticus alboguttatatus.*

mano'o a'au, *n.* *Alticus striatus.*

mano'o gatala, *n.* *Salarias brevis.*

maomao, *n.* Name applied to young *pala'ia.*

māoa'e, *n.* *Gymnothorax javanicus.*

masamie (?), *n.* *Cheilio inermis.*

mata, *n.* Eyes; face; appearance.

mata-'ele'ele, *n.* *Lethrinus harak.*

mata-i-taliga, *n.* Name applied in Samoa to the hammer-head shark, *Sphyrna zygæna*, signifying "eyes-in-ears."

mata-pula, *n.* Name applied to a red-and-white mottled fish, *Priacanthus cruentatus*, having its iris marked with bright red blotches. (See *pula.*)

matagi pulepule, *n.* *Chætodon reticulatus.*

matagi, *n.*, *v.* Wind; to blow.

matalau, *n.* *Pseudupeneus chryserydros.* Name probably derived from barbels, called *lau*, like *lau ulu*, hair of the head.

matalau uliuli, *n.* *Pseudupeneus bifasciatus.*

matu, *n.* *Xystæma argyreum.*

matu loa, *n.* *Xystæma gigas.*

matu mutu, *n.* *Kyphosus waigiensis.*

mea, meamea, *adj.* Young; an infant.

mea, meamea, *adj.* Yellowish brown, brownish; *mea* (Tahiti), to be red, as the skin after eating fish.

mea-sili, *adj.* Exceedingly young.

mimi, *v.* To urinate.

misimisi, *n.* *Plectorhynchus crassispinus.*

misimisi, *v.* To smack the lips.

moai (?), *n.* *Cheilio inermis.*

moaga, *n.* *Pseudupeneus* sp.

moaga faiava, *n.* *Pseudupeneus moana.*

moamoa, *n.* *Lactoria cornuta*, a horned trunk-fish. In Hawaii *moamoa* signifies a sharp point or spur at the stern of a canoe; the word may possibly be derived from *moa* (cock), as many of the Ostraciidæ have spurs,

moamoa samasama, *n.* *Ostracion sebæ.* (See *samasama.*)

moamoa uli, *n.* *Ostracion tuberculatum.*

moamoa uliuli, *n.* *Tetraodon hispidus.*

moana, *n.* *Hepatus guttatus.*

moana, *n.* The ocean.

moana, *adj.* Ocean-blue. *Lanu-moana*, color of the ocean, sea-blue, sky-blue.

molemole, *n.* *Novaculichthys tæniurus.*

moloasi, *n.* *Monacanthus melanocephalus.*

moloasi, *n.* A toadstool; fungus.

mu, *v.* To glow, to become red.

mumea, *n.* *Lutianus bohar.*

mumu, *n.* To be red or ruddy, a sign of beauty.

mumu moana, *n.* *Monotaxis grandoculis.*

mutu, *n.* *Holotrachys lima*, a red squirrel-fish.

mutu, *adj.* to be cut off, blunt, truncated.

mutu uli, *n.* *Megaprotodon trifasciatus.*

nanue, *n.* Name applied to several species of snappers (*Lutianus* species). The word is sometimes pronounced *lanue* or *nganue* by the Samoans, who are apt to be careless in their use of consonants.

nefu, *n.* A name applied to small fish swimming in shoals, like anchovies. The name probably has the same origin as *nefunefu* (Samoa), to be turbid; *nehunehu* (Hawaii), a multitude; *nehu-tai* (New Zealand), sea-spray.

nofu, *n.* Name applied to toad-fishes, *Scorpænopsis gibbosa*, and *Synanceja verrucosa.* *Nohu* (Mangaia), the name of a fish having poisonous spines; *nufu* (Guam), a toad-fish, *Synanceja verrucosa.*

pa'e, pa'epa'e, *adj.* White; light-colored.

paipai (New Zealand), *n.* A cutaneous disease; *paipai* (Hawaii), to peel off, as the bark of a tree or the skin of an animal.

pa'ipa'i, *n.* The name of a fish. *Pa'ipa'i* (Samoa), useless, to no purpose. In many cases *pa'ipa'i* is probably a corruption of *pa'epa'e*, white.

pala, *n.* Mud; *parapara* (New Zealand), mud, dirt.

pala 'ia, *n.* The name of a fish which is called *maomao* when very young and *logouli* when changing to the adult stage.

palagi, *n.* A name applied to *Ctenochætus striatus.*

palagi samasama, *n.* *Hepatus aquilinus.*

pa'ofu, *n.* Name applied to *Eleotris fusca*, *Mapo fuscus*, and other gobies; *oopu* in Hawaii.

pa'u, *n.* Skin, rind, bark.

pa'u 'ulu, *n.* The rind of the breadfruit. A name applied to *Siganus marmoratus.*

pa'u-mai-moana, *n.* A poetic name applied to the bonito.

pa'u-masunu, *n.* A poetic name applied to the bonito.

pa'u-mea, *n.* *Monacanthus melanocephalus.*

pauli, *adj.* Purple.

paumutu (?), *n.* *Hemigymnus melapterus.*

pe'ape'a, *n.* A bat; a swift (bird).

pe'ape'a uli, *n.* *Platax orbicularis.*

pela, *n.* A name applied to the *filoa* (*Lethrinella miniata*).

pelupelu, *n.* *Harengula commersoni.*

pine, *n.* A shoal of young fishes.

pipi, *n.* *Abudefduf metallicus.*

pipine, *n.* The name of a fish.

poi, *n.* The name of a small fish.

pone, *n.* A name applied to surgeon-fishes, *Hepatus* species.

pone i'u mumu, *n.* *Hepatus achilles.*

potati (?), *n.* *Cirrhitus marmoratus.*

pua'a, *n.* A hog; *mata-pua'a*, hog-faced.

pula, *adj.* Shining, glowing. *Pura* (Tahiti), a spark of fire; *pura* (Mangaia), having anything like dust in the eyes.

pulepule, *adj.* Spotted; striped with various colors. *Pulepule* (Hawaii), spotted, speckled, of various colors; *bulebule* (Tonga), spotted.

pusi, *n.* General name for sea-eels (*Gymnothorax, Echidna, Leptocephalus*). *Puhi* (Hawaii), a sea-eel; *puhi* (New Zealand), a large eel; *puhi* (Tahiti), an eel; *puhi* (Mangaia), a sea-eel, which bites severely.

pusi 'ai'aiuga, *n.* *Echidna leihala.*

pusi gatala, *n.* *Gymnothorax pictus; G. flavomarginatus.*

pusi pulepule, *n.* *Gymnothorax undulatus.*

pusi sulusulu, *n.* *Scuticaria tigrina.*

pusi tafa'ilautalo, *n.* Same as *tuna tafa'ilautalo*, an eel.

safole, *n.* A fish found in salt water, *Kuhlia tæniura.*

saga, *n.* Flipper of a turtle.

sama, samasama, *adj.* Yellow.

samasama, *n.* *Zebrasoma flavescens.*

sami, *n.* The sea; salt water. *Gata sami* ("sea-snake"), *Oceanops latovittata.*

sausau, *v.* To flutter the wings.

sausaulele, *n.* "To fly fluttering," *Dendrochirus sausolele.*

sega, *n.* A paroquet kept in captivity for the sake of its red feathers.

segasega, *n.* *Holocentrus ruber.*

segi, *v.* To burn a scar as a beauty-spot.

segisegi, *n.* *Acanthurus unicornis*, a species having brightly colored spots about the spurs on the tail.

sele, *n.* A bamboo knife. *Hele* (Tonga), a bamboo knife; *sele* (Fiji), a bamboo knife.

sesele, *n.* A perch-like fish found in fresh water, *Kuhlia marginata;* when full grown called *inato.*

sila, *n.* Extremity of rainbow.

si'u, *n.* The name of a fish.

si'u muti, *n.* The name of the *lalafi* (*Cheilinus diagrammus*) when full-grown.

siuli (?), *n.* *Chætodon setifer.*

sisi, *n.* Eyes of a cocoanut.

sisitui, *n.* *Amanses scopas*, a file-fish with spines on each side of tail.

sola, *v.* To run away; to escape.

solasulusulu, *v.* To flee and hide away.

soloalalo, *n.* One kind of sea-eel.

sue, *adj.* To be puffed out; to project, as a fat belly.

sue, *n.* A name applied to puffers (*Tetraodon*).

sue mimi, *n.* "Urinating puffer," *Canthigaster solandri.*

sugale, *n.* General name applied to wrasse-fishes of the genera *Anampses*, *Thalassoma*, and *Cheilinus;* meaning choice.
sugale, *n.* *Gomphosus tricolor; Thalassoma fuscum; Cheilinus diagrammus.*
sugale aloa, *n.* *Hemigymnus melapterus.*
sugale 'ele (?), *n.* *Thalassoma dorsale.*
sugale gasufi, *n.* *Cheilinus chlorurus.*
sugale sa'a'ele'ele, *n.* *Thalassoma dorsale.*
sugale lupe (**pule** ?), *n.* *Anampses cæruleopunctatus*, a blue-spotted wrasse.
sugale mata-mumu, *n.* *Cheilinus trilobatus.*
sugale pulepule, *n.* *Thalassoma dorsale.*
sugale uliuli, *n.* *Labrichthys cyanotænia.*
sulu, *v.* To take refuge in.
sulusulu, *v.* To hunt with a torch.
sumu, *v.* To stick into the body like a spear.
sumu, sumusumu, *n.* Name applied to trunk-fishes or trigger-fishes (*Balistes*).
sumu i'u-mumu, *n.* *Balistes vidua.*
sumu-pa'epa'e, *n.* *Balistapus chrysopterus.*
suma-pa'epa'e mumu, *n.* *Balistes flavomarginatus.*
sumu pulepule, *n.* *Balistapus rectangulus.*
sumu uli, *n.* *Balistapus aculeatus.*
sumu uliuli, *n.* *Balistapus aculeatus.*
susu, *n.* Nipples, teats.
susu umi, *n.* *Chorististium susumi.*
tā, *n.* To jump a somersault. *Lupo ta*, *Caranx plumbeus.*
tafa'i, *n.* To break off, as a leaf.
tagi, *v.* To weep; to mourn.
tagitagi, *n.* *Hemigymnus melapterus.*
tagau, *n.* *Lutianus marginatus.*
tai, *n.* Sea, salt-water.
tāiva, *n.* Name applied to a snapper, *Lutianus marginatus*, and to *Scolopsis trilineata.*
tāiva uliuli, *n.* *Lutianus monostigma.*
ta'i-ono, *adj.* Six by six; by sixes; six on a side.
tala, *n.* The spur of a cock, barb of a spear.
talae, *n.* *Periophthalmus barbarus*, air-breathing fish found in mangrove swamps; mangrove-hopper.
tali, *v.* To wait for; to stand by to do something.
taliuli, *v.* To steer, without assisting to paddle.
talitaliuli, *n.* One who follows in the train of another; one who waits about for food. Name applied to the pilot-fish, *Leptecheneis naucrates.*
talinga, *n.* Ear. *Taringa* (New Zealand), ear; *dalinga* (Fiji), ear; *talinga*, *tainga* (Malay), ear; *talanga* (Guam), ear.
tamala, *n.* Name applied to young *taira.*
tanifa, *n.* A large man-eating shark (*Carcharias*). *Taniwha* (New Zealand), a water-monster; *danira* (Fiji), one kind of shark.
tao, *n.* A spear. *Tao* (Polynesia generally), a spear; *kao* (Hawaii), a spear or javelin; to throw or dart a spear.
taotao, *n.* *Microphis brachyurus.*
tao-tito, *n.* *Aulostomus valentini.* *Tito*, to fall headlong.
taoto, *n.* *Parapercis tetracinctus; Zenarchopterus vaisiganis; Valenciennea violifera.*
ta'uleia, *n.* *Pseudupeneus indicus; Ps. barberinus.*
taupou, *n.* A virgin; the princess of a village. A name applied to several demoiselle-fishes, especially to *Pomacentrus pavo*, *Abudefduf uniocellatus*, and *Abudefduf taupou.*
tea, teatea, tetea, *adj.* White, light-colored, albino. *Kea* (Hawaii), white.
tega, *n.* Thigh; upper arm.
ti'ava, *n.* *Lutianus gibbus.*

tifi, *v.* To adorn. *Kihi* (Hawaii), the outside corner or projection of a thing, the apex of a leaf; *kihikihi* (Hawaii), the curving of the horns of the moon, the curving of the wings of a bird; *mano kihikihi* (Hawaii), the hammer-head shark.

tifitifi, *n.* General name for chætodonts or butterfly-fishes and small fishes resembling them.

tifitifi a'au pulepule, *n.* *Chætodon ornatissimus.*

tifitifi 'ao, *n.* *Chætodon reticulatus.*

tifitifi laumea, *n.* *Chætodon lunula.*

tifitifi tala, *n.* *Chætodon trifasciatus.*

tifitifi, *n.* *Zanclus canescens.*

tifitifi ila, *n.* *Chætodon ephippium.* *Ila*, a birthmark on the skin.

tifitifi i'u-sama, *n.* *Chætodon pelewensis.*

tifitifi lauifi, *n.* *Chætodon citrinellus.*

tifitifi magina (?), *n.* *Chætodon citrinellus.*

tifitifi mata-niu, *n.* *Chætodon vagabundus.*

tifitifi paipai, *n.* *Chætodon mertensi.*

tifitifi pulepule pa'ipa'i, *n.* *Chætodon melannotus.*

tifitifi pulepule samasama, *n.* *Chætodon unimaculatus.*

tifitifi sama, *n.* *Chætodon setifer.*

tifitifi taiono, *n.* *Chætodon ephippium.*

tifitifi tusa, *n.* *Chætodon ephippium.*

tifitifii uli, *n.* *Chætodon citrinellus.*

tito, *n.* *Aulostomus valentini*, a trumpet-fish; *tito* (Samoa), to dart or fall headlong.

tolai, *n.* A name of two birds, *Petroica pusilla* and *Myzomela nigriventris.*

tolai, *n.* *Gnathodontex aurolineatus.*

toto, *n.* *Monodactylus argenteus.*

tui, *v.* A spine; to thread a needle; to run a string through.

tuna, *n.* An eel, *Anguilla* sp. *Tuna* (New Zealand), an eel; *tuna* (Tonga), an eel; *duna* (Fiji), an eel; *tona* (Madagascar), the largest kind of eel.

tuna gatala, *n.* *Anguilla mauritiana.*

tuna tafa'ilautalo, *n.* See *pusi tafa'ilautalo.*

tusi, *n.* *Scolopsis trilineata.*

tusitusi, *n.* Striped. *Tusi*, to mark.

tusa, *n.* To be equal; the same on both sides.

tu'ū'u, *n.* Name applied to fish with a broad, compressed body, as *Pomacentrus nigricans*, *Abudefduf leucopomus*, and *Abudefduf dicki.*

tu'u'u pulepule mumu, *n.* *Holocanthus bispinosus.*

uga vai, *n.* *Hepatus elongatus.*

ui, *adj.* Dark colored; *ili-ui*, dark-skinned

ui, *v.* To pass along.

uisila, *n.* Name applied to *Atherina* sp.

'ula, 'ula 'ula, *adj.* Red. *Kula* (Tonga), red; *kura* (New Zealand), red; *ura* (Tahiti), red feathers; *ulaula* (Hawaii), red; *kulakula* (Fiji), red.

ulavāpua, lava-ula-pua, vala-ula-pua, *adj.* Black in the fore and hind parts and white in the middle.

ulavāpua, *n.* *Pomacentrus albofasciatus; Abudefduf sordidus.*

ula pua, *n.* *Holocanthus bicolor.*

uli, uliuli, *adj.* Dark blue, black.

uli, *v.* To steer.

ulitui, *n.* *Pseudogobiodon citrinus.*

uliuli (usiusi?), *n.* *Megaprotodon trifascialis.*

ulu, *n.* Head.

'ulu, *n.* Breadfruit.

ulua, *n.* *Caranx forsteri.*

ume, *n.* A name applied to surgeon or lancet fishes, species of *Hepatus* and *Acanthurus.*

umelei, *n.* *Hepatus matoides, Acanthurus lituratus, Acanthurus unicornis.*

umi, *v.* To lengthen out. (See *gutu umi*, *Epibulus insidiator*, from the protractile jaws.)

umue (?), *n.* *Kyphosus waigiensis.*

usi, usiusi, *adj.* Green.

usiusi, *n.* *Callyodon* (juv.).

usiusi (?), *n.* *Megaprotodon trifascialis.*

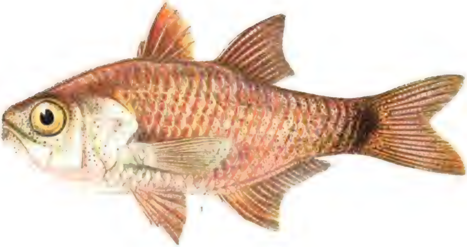
va'a, *n.* Boat, canoe; *vaka* (Tonga), a boat; *waka* (New Zealand), a canoe; *waa* (Hawaii), a canoe.

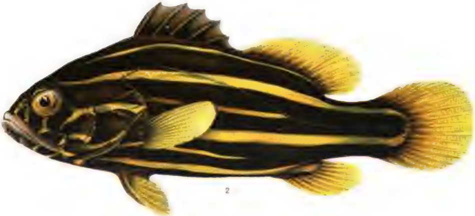
vae, *n.* Foot, leg.

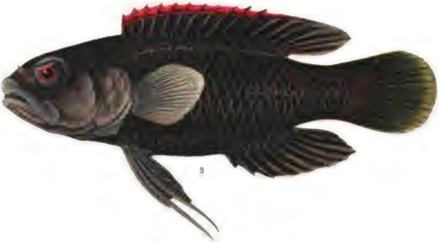
vai, *n.* Fresh water; *wai* (Hawaii and New Zealand), fresh water.

vaiuli sama, *n.* *Abudefduf taupou*, *Pomacentrus vaiuli.*

vete, *n.* A surmullet, *Upeneus vittatus.* *Weke* (Hawaii), *Mulloides* sp.

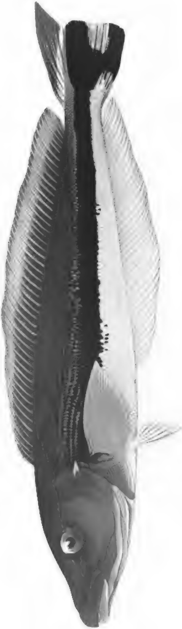




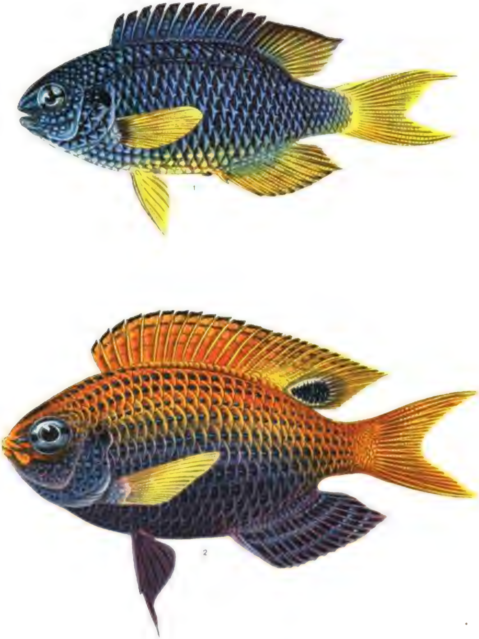


1 ARCHAMIA LINEOLATA (EHRENBERG)
2 GRAMMISTES SEXLINEATUS (THUNBERG)
3 PHAROPTERYX MELAS (BLEEKER)

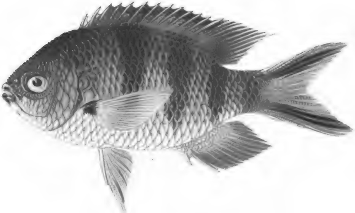
A HOEN & CO.

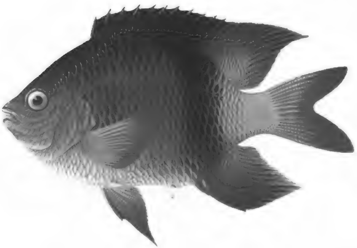


OCEANOPS LATOVITTATA (LACÉPÈDE)

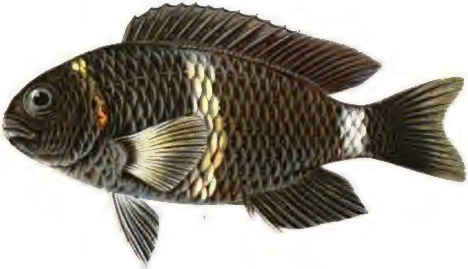


1 POMACENTRUS PAVO (BLOCH)
2 POMACENTRUS VAIULI JORDAN & SEALE





1 ABUDEFDUF CŒLESTINUS (CUVIER & VALENCIENNES)
2 ABUDEFDUF DICKI (LIÉNARD)



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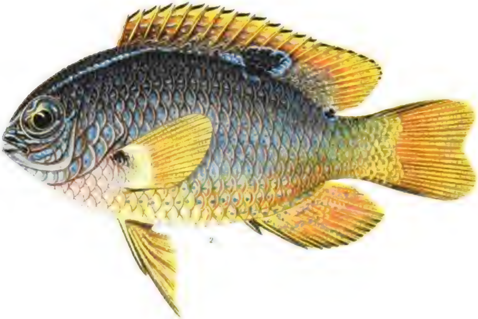

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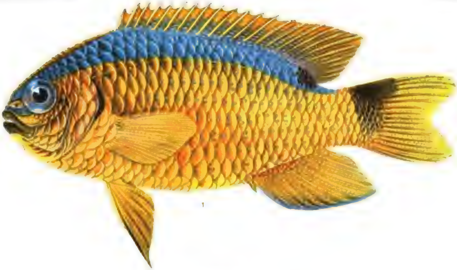
1 ABUDEFDUF AMABILIS (DE VIS)
2 ABUDEFDUF ANTJERIUS (KUHL & VAN HASSELT)



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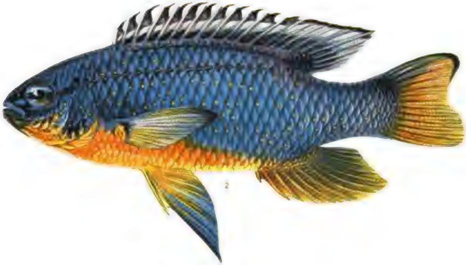

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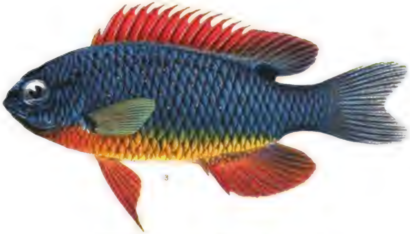

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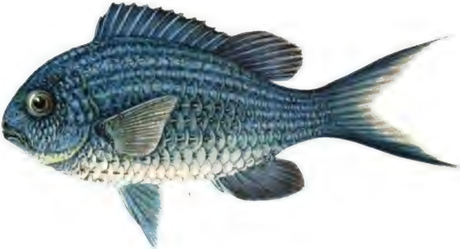
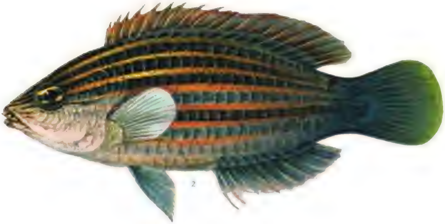
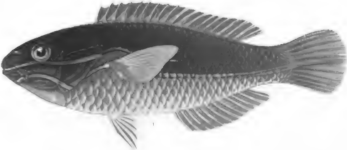
1 ABUDEFDUF LEUCOPOMUS (CUVIER & VALENCIENNES)
2 ABUDEFDUF UNIOCELLATUS (QUOY & GAIMARD)
3 ABUDEFDUF TAUPOU JORDAN & SEALE. TYPE





1 CHROMIS CÆRULEUS (CUVIER & VALENCIENNES)
2 PSEUDOCHEILINUS HEXATÆNIA BLEEKER



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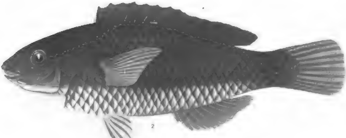

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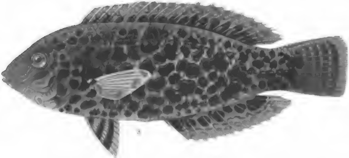

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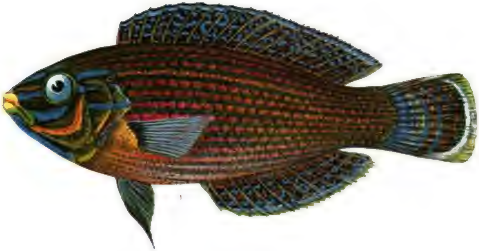
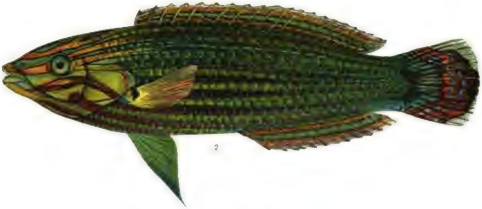
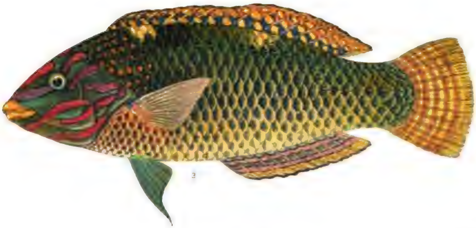
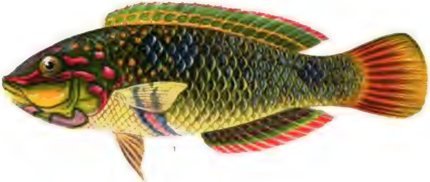
1 STETHOJULIS CASTURI GÜNTHER
2 STETHOJULIS BANDANENSIS (BLEEKER)
3 LEPTOJULIS PARDALIS KNER







1 PLATYGLOSSUS MARGINATUS (RÜPPELL)
2 PLATYGLOSSUS FLOS-CORALLIS JORDAN & SEALE. TYPE
3 HALICHŒRES CENTIQUADRUS (LACÉPÈDE)



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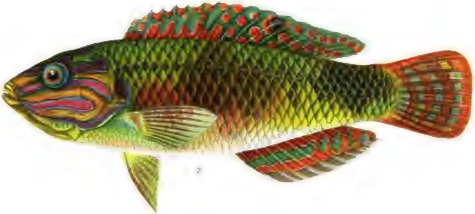

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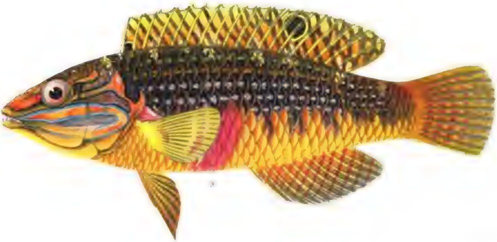

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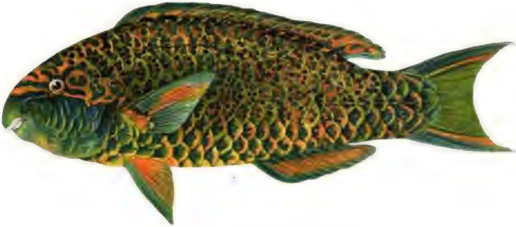
1 HALICHŒRES TRIMACULATUS (QUOY & GAIMARD)
2 HALICHŒRES DÆDALMA JORDAN & SEALE
3 HALICHŒRES OPERCULARIS (GÜNTHER)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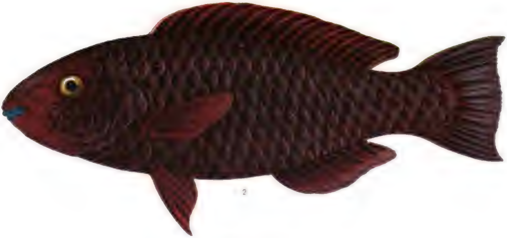
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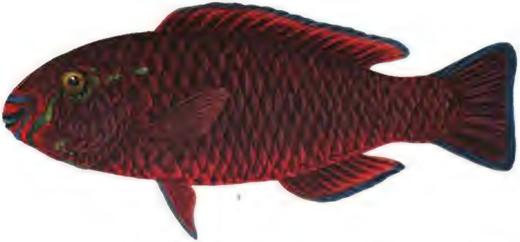
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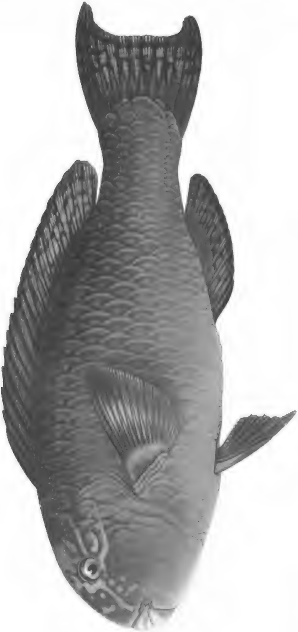
1 CALLYODON SPILONOTUS (KNER)
2 CALLYODON PRASIOGNATHUS (CUVIER & VALENCIENNES)
3 CALLYODON MAORICUS JORDAN & SEALE



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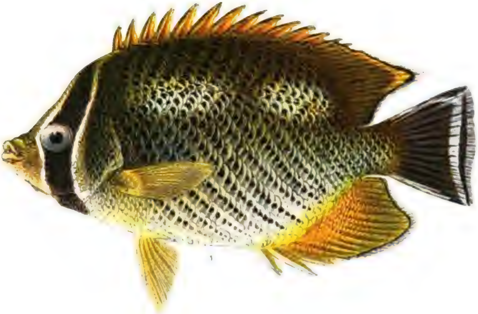
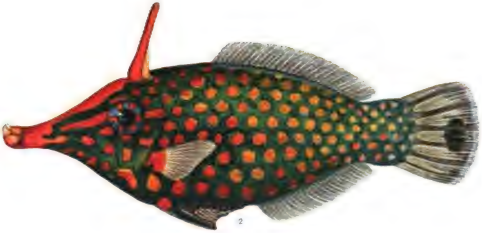
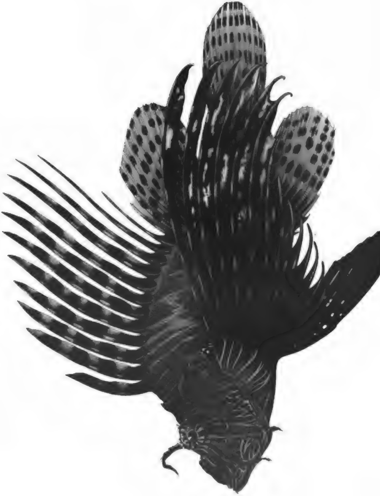




1 MEGAPROTODON TRIFASCIALIS (QUOY & GAIMARD)
2 OXYMONACANTHUS LONGIROSTRIS (BLOCH & SCHNEIDER)



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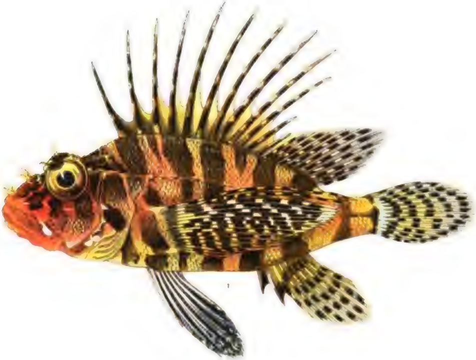
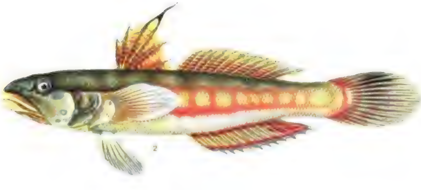
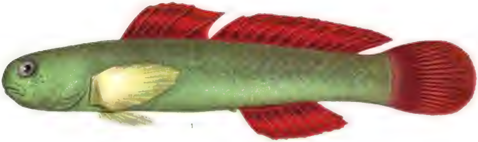




1 DENDROCHIRUS SAUSAULELE JORDAN & SEALE
2 VALENCIENNEA VIOLIFERA JORDAN & SEALE. TYPE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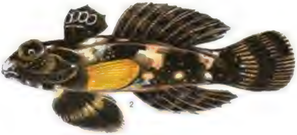
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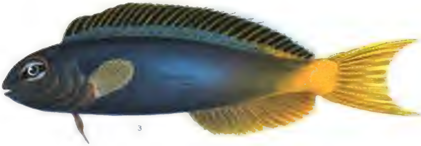
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1 KELLOGGELLA CARDINALIS JORDAN & SEALE TYPE
2 SYNCHIROPUS LILI JORDAN & SEALE. TYPE
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